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**FAO/JAPAN GOVERNMENT COOPERATIVE PROGRAMME GCP/INT/788/JPN**

**Report and documentation of the**

# INTERNATIONAL WORKSHOP ON FACTORS CONTRIBUTING TO UNSUSTAINABILITY AND OVEREXPLOITATION IN FISHERIES

**Bangkok, Thailand, 4-8 February 2002**

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## PREPARATION OF THIS DOCUMENT

With financial support from Japan, an FAO project was initiated in 2001 to address issues related to factors of unsustainability and overexploitation in fisheries (Project GCP/INT/788/JPN). The aim of this project is to develop ways and means to better address major factors of overexploitation and unsustainability, giving special consideration to providing guidance on action that could be taken towards improving sustainability and food security in general and, in particular, towards the implementation of major international fisheries instruments.

An international Workshop on factors of unsustainability and overexploitation in fisheries was organized in the context of this project from 4 to 8 February 2002 in Bangkok, Thailand.

The present document contains the report of the Workshop, the discussion papers that were prepared by FAO to serve as reference documents and as a basis for group work, as well as notes submitted to the Workshop by some of the participants. In the present document, no attempt was made to analyse findings or to revise accordingly the papers presented at the Workshop. This document and, in particular, the conclusions and recommendations adopted by Workshop participants will serve as a basis for further work aimed at improved fisheries management and a more effective implementation of major international fisheries instruments.

The document was compiled and edited by Dr Dominique Gréboval, Senior Fishery Planning Officer (FAO Fisheries Department) and Technical Secretary of the Workshop.

Distribution:

Participants in the Workshop
FAO Fisheries Department
Fisheries Officers in FAO Regional Offices

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## ABSTRACT

An international workshop was organized in order to review and assess factors contributing to unsustainability and overexploitation in fisheries. The workshop addressed, *inter alia*, the following questions: What are the key factors contributing to fisheries unsustainability and overexploitation and how do these factors interact in general and under major fisheries management systems? Which are the priority issues in addressing fisheries unsustainability and overexploitation and what are the best practical approaches to address these factors in order to contribute to responsible fisheries management?

Preliminary considerations were also given to related issues such as how and in what way these factors were addressed in international fisheries instruments and whether the current instruments are sufficient to address these factors.

This document contains the report of the workshop as well as discussion papers prepared for the workshop and notes submitted by participants. This document and, in particular, the conclusions and recommendations adopted by Workshop participants can serve as a basis for further work aimed at improved fisheries management and a more effective implementation of major international fisheries instruments.

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# INTRODUCTION

World marine capture fisheries are now close to the forecasted catch ceiling of conventional resources - about 100 million tonnes per annum. Major resources are already overexploited and there are widespread concerns about collapsing stocks, over-capacity in fishing fleets, unsustainable fishing practices and environmental degradation.

Worldwide concern about the state of fishery resources and about some of their non-sustainable uses has led to questioning the performance of present production and management systems. Despite the fact that a potential still exists for further development in some fisheries, many fisheries are perceived as ill-managed. Whilst the international legal framework for fisheries management has been substantially improved by a series of new agreements, the web of intersecting provisions that they contain substantially complicates their simultaneous implementation and greatly increases the need for a better understanding of the factors leading to overexploitation and unsustainable fisheries.

Overexploitation and fisheries unsustainability have been a major concern of fisheries managers and policy makers for at least half a century. This phenomenon occurs in most parts of the world. A wide range of factors could be at the origin of this problem, e.g. the widespread tendency of private and public over-investment, the prevalence of relatively open-access conditions not only in the high seas but in many other fisheries, the lack of political will to bring fisheries under effective control, international competition, the degradation of the marine environment, and the imbalanced state of many marine ecosystems.

To address these concerns, the international community has made several attempts to develop and enhance policy instruments. Such international fisheries instruments[1] include: the United Nations Convention on the Law of the Sea (UNCLOS); the Code of Conduct for Responsible Fisheries; the Compliance Agreement; the UN Fish Stocks Agreement; and the Cancun, Kyoto, United Nations Conference on Environment and Development (UNCED) and Rome Declarations. Recently the International Plan of Action for the Management of Fishing Capacity and the International Plan of Action to Combat Illegal, Unregulated and Unreported Fishing were also adopted.

These instruments impose specific duties or responsibility upon the States and regional fishery bodies on a mandatory or voluntary basis. They address issues such as: unregulated fishing; overfishing; bycatch and discards; unreliable data and statistics; use of precautionary approach; management of high-sea fish stocks; Monitoring, Control and Surveillance (MCS) and enforcement by Flag and Port States; marine pollution; data gathering and management advice; and assistance to developing states.

Although there has been considerable progress by some States and regional fishery bodies on the implementation of these instruments, difficulties still exist with respect to ensuring a wider international commitment to their implementation and a more efficient application of their provisions in practical terms. Effective implementation raises complex scientific, managerial and political considerations that cannot be resolved quickly. A time-lag is therefore observed between: the global endorsement of any particular instrument; a national

[1] These instruments are presented in Discussion Document 2, *infra*.

or regional policy decision to act on this instrument; and its effective implementation. Delay of the implementation often aggravates fisheries unsustainability.

Another difficulty is that factors contributing to fisheries overexploitation and unsustainability are still not widely understood. Active mechanisms at work and impacts are yet to be assessed. Methodologies to be used in the analysis of such factors and the assessment of their complex interaction are still lacking.

With financial support from Japan, an FAO project was initiated in 2001 to address some of these issues: Project GCP/INT/788/JPN: *Factors of Unsustainability and Overexploitation in Fisheries*. The aim of this project is to develop ways and means to better address major factors of overexploitation and unsustainability, with special consideration being given to providing guidance on actions that could be taken towards improving sustainability and food security in general and, in particular, towards the implementation of major international fisheries instruments.

The *Workshop on Factors Contributing to Unsustainability and Overexploitation in Fisheries* was organized in the context of this project. The workshop was attended by 24 experts from a wide range of countries, attending in their personal capacity and representing various disciplines and experiences relevant to fisheries management. It was held from 4 to 8 February, 2002 in Bangkok, Thailand.

The workshop addressed the following questions:

- What are the key factors contributing to fisheries overexploitation and unsustainability?
- How do these factors interact, in general and under major fisheries management systems?
- Which are the priority issues in addressing fisheries overexploitation and unsustainability?
- What are the best practical approaches to address these factors in order to contribute to sustainable and responsible fisheries management?

Preliminary consideration was also given to related issues such as:

- How and in what way these factors were addressed in international fisheries instruments and are the current instruments sufficient enough to address these factors?
- Is the relationship among factors duly taken into account by existing instruments?

Two discussion papers were prepared by FAO to serve as reference documents for the workshop and as a basis for group work on these issues.

The present document contains the report of the workshop, the aforementioned discussion papers as well as notes submitted to the workshop by participants. No attempt was made at this stage to analyze findings and revise the documentation - which is presented in this document as working material. This document and, in particular, the conclusions and recommendations adopted by workshop participants will serve as a basis for further work aimed at improved fisheries management and a more effective implementation of major international fisheries instruments.

# PART I: REPORT OF THE WORKSHOP ON FACTORS CONTRIBUTING TO UNSUSTAINABILITY AND OVEREXPLOITATION IN FISHERIES

## 1. INTRODUCTION

The International Workshop on Factors Contributing to Unsustainability and Overexploitation in Fisheries was held from 4 to 8 February, 2002 in Bangkok, Thailand. The workshop was organized in the context of an FAO trust fund project (Project GCP/INT/788/JPN: *Factors of Unsustainability and Overexploitation in Fisheries*). It was hosted by the FAO Regional Office for Asia and the Pacific.

The workshop was attended by 24 experts from 18 countries as well as by 5 observers. Experts attended this Workshop in their personal capacity. Various disciplines and experiences relevant to fisheries management were represented. The list of participants is attached as Appendix B.

The Workshop was opened by Dr R.B. Singh, Assistant Director-General of FAO and Regional Representative for Asia and the Pacific. In his opening remarks, Dr Singh recalled the much deteriorated state of fisheries resources worldwide and its detrimental impact on food security, industry performance and livelihoods in fishing communities. He emphasized that resource overexploitation and related unsustainable outcomes still very much prevail in spite of growing awareness of the need to improve fisheries management and of numerous initiatives undertaken over the last 7 years at international level towards this end. Dr Singh underlined the relevance of this workshop to finding new avenues towards improved governance in fisheries. He thanked the Government of Japan for the support provided and wished the Workshop every success in this difficult task. A copy of the opening speech is given in Appendix C.

Mr Rögnvaldur Hannesson was elected as the Chairperson of the Workshop. The Agenda adopted by the Workshop is attached as Appendix A. As indicated in the agenda, the workshop was organized around plenary and working group sessions.

The Technical Secretary of the Workshop, Mr Dominique Gréboval, recalled that the objectives of the Workshop were to identify factors of unsustainability and overexploitation in fisheries and to discuss such factors in relation to fisheries management. He also emphasized that the ultimate aim of this work was to improve fisheries management approaches, with emphasis being given to the implementation of relevant international fisheries instruments.

Two Discussion Papers were presented (see Part II). A paper prepared by Mr Steve Cunningham and Mr Jean-Jacques Maguire discussed factors of unsustainability in fisheries. This paper provided the basis for plenary discussion and group work on this issue. A paper prepared by Mr Michael Lodge reviewed tentative linkages between such factors and major international fisheries instruments. Participants also contributed notes that were distributed during the Workshop (see Part III).

## 2. BACKGROUND DISCUSSION ON FACTORS OF UNSUSTAINABILITY AND FISHERIES MANAGEMENT

The identification of factors of unsustainability in fisheries and the relationship between key factors of unsustainability and to fisheries management were addressed on the basis of Discussion Paper I. These related topics were presented by the authors of this paper, Steve Cunningham and Jean-Jacques Maguire.

The authors noted the widespread concern about the precarious state of world fisheries and its negative consequences on food security, the socio-economic well-being of communities, and the stability of ecosystems. This trend towards unsustainability has occurred despite the concept of sustainability being central in fishery management. Unsustainability, like sustainability, has several components (ecological, socio-economic, community, institutional) and there is no universally accepted quantified definition of sustainability. The paper examines how factors influence the different components of sustainability.

Unsustainability is closely linked with overexploitation, but some resources may be unsustainable even in the absence of exploitation – marine ecosystems evolve over time and conditions may become unfavorable for a given species in a given area. In addition, natural catastrophes may eradicate some species from some areas. Resources are also vulnerable to human – made habitat modifications not related to fisheries exploitation. Resource dynamics are not deterministic and there is no guarantee that a given action will automatically result in the expected response from the resource: decreases in fishing mortality have often resulted in stock rebuilding but not always. Fishery management is concerned with managing the activities of humans, not those of the fish.

The authors recalled that factors of unsustainability are examined in the paper under six stylized fishery management scenarios: no management, technical conservation measures, input controls, overall output controls, use rights, and market based measures. Co-management is an institutional arrangement that can be applied to any of the scenarios where management is implemented.

It was noted that uncertainty is a major factor of unsustainability, and that its effects increase as the fishery management system becomes more elaborate. In the absence of management, fishers are confronted with uncertainties related to the natural variability of the environment and of that of the markets. Under active management, uncertainties about management decisions, their effects and their implementation are added. Current fishery management approaches have evolved from control theory which may not be appropriate to control unpredictable and complex systems such as fisheries.

It was also noted that unsustainability was related to fisheries management itself, e.g. in terms of weak institutional systems; unrealistic policy goals; poor choices of policy instruments and ineffective implementation; insufficient overview of the broader context of a fishery under management (ecosystem and sector interactions) and a fire-fighting approach that often reflects a lack of attention being paid to the management process itself.

Following the presentation of the Discussion Paper, participants raised a number of issues to be addressed by the two Working Groups. A résumé of comments made is provided below (also refer to Section III for more details on the written comments and contributions provided by participants).

The Workshop felt that it was most opportune to widen the perspective on management and responsible fisheries by an analysis of factors of unsustainability. It was noted that definitions of (un)sustainability are many and that these generally imply that (un)sustainability be addressed in a multi-dimensional manner and in connection to societal values (expressed as reference points, conventions or thresholds). Approaches that could be useful to discussing factors of unsustainability were mentioned, such as: the Pressure-State- Response (PSR) and the precautionary approach, and the need to account for trade-offs between various dimensions of unsustainability (e.g. resource vs. economic vs. social).

It was suggested that in poor countries unsustainability would be strongly linked to factors such as poverty, demography, and deteriorating environmental and socio-economic conditions. A scaled approach to understanding the issue of unsustainability was proposed (from the local/community level up to the national or international level).

Some participants recommended that case studies of selected fisheries be undertaken for the purpose of better understanding factors of unsustainability (in general and in relation to specific management measures). Participants were informed of related initiatives undertaken by the International Council for the Exploration of the Sea (ICES) and the European Union (EU). However, the Workshop was relatively divided on this issue, and some participants expressed reservations on the usefulness of such case studies given the difficulty of deriving strong evidence from a few situation-specific studies (especially if multi-dimensional and based on fisheries with heterogeneous backgrounds).

Participants were also divided on the approach to be followed to review factors of unsustainability. Some expressed the view that using a management matrix (i.e. to structure the analysis along typical management methods as done in the Discussion Paper) allowed for a more systematic account of factors and their interaction with the management process itself. Others felt that more emphasis should be given first to identifying the properties of fisheries systems that are sensitive to unsustainability, with emphasis being given to linkages between factors.

Discussions on this issue led the Workshop to decide that the two Working Groups would follow a different approach in addressing the identification of factors of unsustainability and in relating these factors to fisheries management. Working Group 1 structured its work in relation to a list of typical methods used in fisheries management, whereas Working Group 2 based its analysis on a PSR approach. The two approaches were considered complementary.

The two working groups were established. Mr Jack Rice and Mr Poul Degnbol were respectively elected as Chairpersons of Working Groups 1 and 2. The summary reports prepared by the working groups are presented below in sections 3 and 4.

## 3. SUMMARY REPORT OF WORKING GROUP 1

This Working Group began with a relatively long discussion of issues relating to unsustainability in order to identify key features of the concept - rather than attempting to provide a precise definition - and to agree on the principal factors of unsustainability. This discussion and the factors identified by the Group are presented in the first section.

**Issues related to unsustainability**

Features

Much of the discussion of unsustainability inevitably involves reference to sustainability. A first feature is that sustainability must be more than simple persistence of systems, but must involve continued existence at "reasonable/beneficial levels". However, this immediately invites difficulties because culture and values affect judgments of what is "reasonable".

A second feature is that "sustainable" implies maintaining in a "healthy state" and hence unsustainable must involve moving towards an "unhealthy state". The notion of health can be addressed in many different ways. The Working Group discussed this in terms of the following four dimensions of sustainability:

- Economic Health. The parameters are well defined (profit, employment and rent). Growth may be inconsistent with ecological carrying capacity if growth is interpreted in terms of production alone. It is important to focus also on value.
- Ecological Health. There is a diversity of views among responsible professionals. The working group was not sure that there exists a complete science-based answer.
- Social Health. This closely relates to social values and cultures.
- Institutional Health. This dimension can be defined in various ways, e.g. social justice or just stable governance?

A third feature was the importance of time: is an unwanted situation likely to be enduring? Discussion of time led into a consideration of irreversibility. The Working Group felt that irreversibility was not likely to be of equal importance for each of the four dimensions above.

- Economic reversibility was likely to be swift, even from adverse situations;
- Ecological reversibility is the usual touchstone;
- Community reversibility was judged quite inconsistent with reality;
- Institutional reversibility was not discussed.

Another important aspect of reversibility noted by the working group is the irreversibility of technological change.

The feature of time was also discussed in terms of adaptation to changing conditions.

- Economic reaction – nearly immediate, but often efforts are made to resist change;
- Ecological reaction – change is a basic condition;
- Community reaction – often very slow;
- Institutional reaction – generally slow, but reaction can sometimes be very swift; depending on the quality of information, and the form of governance.

Factors

In discussing factors, the Working Group felt it important to distinguish between *external* and *internal* factors. An external factor is one which has an effect on the fishery but the fishery has little (or much less) influence on it (one-way effect). An internal factor is one where the fishery has a large influence on the factor, as well as the factor having an influence on the fishery (two-way interaction).

*The Setting (factors that cannot be changed)*

Some factors set the framework within which the fishery operates. The two most important were considered to be:

1. Limit on rate of replenishment of resource base – biological carrying capacities.

2. History (social, cultural, governance) – Cultural and ethical relationship between users and resource. Different in macro-geographic parts of world.

*Factors Relating to the Fishery*

3. Lack of incentives for resource conservation – Lack of use rights.
   → Internal factor and fundamental cause. Must be target for corrective actions.

4. Demand/Value of product.
   - Rate of increase in demand and value of fish.
   - Consumer/cultural preference for ecologically unsustainable products (e.g. egg-bearing females).

   → External factor (background). May be cause or symptom, and opportunity or threat depending on many things. Must be reacted to effectively. Can be target for corrective actions, e.g. eco-certification.

5. Inadequate Governance Systems.
   - Not recognized as legitimate – Internal.
   - Functionally Absent or ineffective – External.

   → Fundamental cause. Must be target for corrective actions.

6. Technology.
   → Internal. Can be opportunity or threat depending on many things, especially incentives/rights. Fundamental cause when not linked to proper incentive regime. Can be target for corrective actions.

7. Low Opportunity Cost & Lack of availability of alternative employment.
   → External or Internal (but fundamental cause). Very influential on options for addressing fundamental causes. Must be target for corrective actions.

8. External Threats or harm to ecosystem (with or without trend).
   Habitat destruction, pollution, major oceanographic events, climate change.
   → Can be fundamental factors (depending on magnitude). May require management response. May be targets for corrective actions (depends on cause).

9. Internal threats to ecosystem.
   - Impact of fisheries on biology of target species.
   - Impact of other fisheries on prey and predators.
   - Impact of gear on habitat.

   → Usually secondary (can become fundamental if persistent). May require management response (depends on magnitude). May be target for corrective action (depends on magnitude).

10. Effectiveness of Management Control.
    - Difficulty of effective management – mixed species fisheries – Internal.
    - Failure of compliance with applicable legal instruments including Codes of Conduct – Internal.
    - Failure of Enforcement by legitimate authorities. – Internal.
    - IUU fishing – not recognizing jurisdiction of regulatory authorities – External.

    → Fundamental in some cases, symptom in others. Can be target for corrective actions. Must be target of corrective action in case of IUU fishing.

11. Fleet capacity & overcapitalization.
    → Internal but symptom of other problems (wrong incentives). Must be target for corrective action (but of causes, not just symptom).

12. Political Impact of Fisheries Interests on case-specific decisions.
    → Internal. Must be target for corrective action.

13. Will of governments to address the sustainability agenda on large scale.
    → External and internal. Must be target for corrective action (enlightenment).

14. Uncertainty.
    Interacts with <u>many</u> other factors on the list, especially factor 8 "environmental variability".
    - Inadequate data (catch, effort, biological, economic, community).
    - Absent data.
    - Unreliable data.
    - Limitations on science (quality, funding, inherent etc).

    → Some external, some internal. All must be addressed effectively in management. Some sources of uncertainty can be targets of corrective action. Some sources of uncertainty are intrinsic. They must be accommodated in management but cannot be "corrected".

15. Poor risk management/lack of scenario planning.
    → Intrinsic. Must be addressed with corrective actions (Commitment to Precautionary Approach).

16. Psychology of fishing (in some contexts).
    Motivation of belief in "bumper catch tomorrow" & risk prone nature of entering fishery.
    → Can be "setting factor" that management must understand. Can be internal factor that requires corrective action.

17. Lack of government stability <u>or</u> lack of belief in accountability.
    May be a particular problem for rights-based fisheries.

**Framework for the analysis of factors of unsustainability**

<u>An approach by geographic strata</u>

After some discussion, the Working Group decided that one interesting approach to the analysis of the factors was to consider the way in which their importance varied according to

geographic strata. The Working Group considered the way that the various factors could be expected to vary in strength or likelihood of occurrence, going progressively from the near-shore stratum (say, 0 to 5 km from shore) out to the high seas. It concluded that only a few patterns of change in importance would be likely to occur. Therefore, rather than provide a tabulation of every possible combination of factor by stratum, it would be more efficient to simply designate which pattern would be associated with each factor.

Three main patterns were identified by the Working Group:

- **Flat.** The factor might be very important or less important on a case by case basis, but there was no reason to assume that pattern would vary systematically with distance from the coastal zone.
- **U-shaped**. The factor was expected to be of high importance in the coastal zone, and in the high seas, although for different reasons. (In the inshore area, the cause is usually the need for spatial detail, for enforcement, or whatever, that is unrealistic, whereas in the high seas the cause is usually a void in authority, scientific information, or whatever). It would be of lesser importance in the intermediate strata.
- **Decreasing.** The factor was expected to be of greatest importance in the 0-5 km stratum, and decrease progressively (although not necessarily smoothly) outward.

When a factor was thought to be 'high' for most or all geographic strata, that point was indicated as well.

Patterns in factors of unsustainability

- Lack of incentives for resource conservation/Lack of use rights: Flat, and expected to be High in all strata.

- Increasing Demand/Value: Flat, and expected to be High in all strata.

- Inadequate Governance Systems: U-shaped.

- Technology: Flat and may be High or fairly Low on case by case basis.

- Low Opportunity Cost & Lack of availability of alternative employment: Decreasing.

- External Threats or harm to ecosystem: Decreasing. Starts High because of vulnerability to coastal-based threats. May be flat and low with risk of severe perturbation due to specific catastrophic events (e.g. oil spill) or environmental regime changes.

- Internal Threats to ecosystem: Flat and may occasionally be high when the threat is related to the trophodynamic effect of fishing or U-shaped when the threat is related to the effect of fishing on habitat.

- Effectiveness of Management Control: U-shaped.

- Difficulty of effective management:
  - Mixed species fisheries: Not certain if factor is Flat and High if relevant, or U-shaped;

  - Failure of compliance with applicable legal instruments including Codes of Conduct: U-shaped;
  - Failure of Enforcement by legitimate authorities: Decreasing, but because of decreasing likelihood that there is a recognized authority in High Seas, not because enforcement effectiveness is as good as within EEZs;
  - IUU fishing – U-shaped.

- Fleet capacity & overcapitalization: Flat and can be high.

- Will of governments to address the sustainability agenda strategically: Flat.

- Uncertainty: U-shaped.

- Poor risk management/scenario planning: Decreasing.

- Psychology of fishing (in some contexts): Decreasing.

- Subsidies: The group was unsure what pattern existed in this factor. It is likely that there is some decline from the closest to the most distant areas, but the diverse nature of what is a subsidy makes the shape of the change in this factor with stratum unclear.

- Wasteful Fishing Practices: Flat; at least the potential for wasteful practices is always present.

**A preliminary application of the framework**

In tabulating the importance of the various factors of unsustainability in different geographic strata and by the different dimensions of unsustainability, it was efficient for presentation to number the factors. In addition, the categories of management approaches that could be considered to address the factors were identified by Roman numerals and partitioned into those directed at the fishery and those directed at the markets and thereby affecting the fishery. These numberings are applied in the following tables.

3.1 Factors of unsustainability

1. Lack of incentives for resource conservation – Lack of use rights
2. Demand/Value
3. Inadequate Governance Systems
4. Technology
5. Low Opportunity Cost & Lack of availability of alternative employment
6. External Threats or harm to ecosystem
7. Internal threats to ecosystem
8. Effectiveness of Management Control
   - Difficulty of effective management – mixed species fisheries
   - Failure of compliance with applicable legal instruments including Codes of Conduct
   - Failure of Enforcement by legitimate authorities. - IUU fishing
9. Fleet capacity & overcapitalization
10. Will of governments to address the sustainability agenda on large scale
11. Uncertainty

12. Poor risk management/scenario planning
13. Psychology of fishing (in some contexts)
14. Subsidies
15. Poor fishing practices

3.2 Management approaches

i. No management

*Measures affecting fishery operations directly*

ii. Technical Measures (Gear restrictions, size regulations, vessels)
iii. Spatial and/or Seasonal Controls (closed areas)
iv. Effort controls (days at sea)
v. Catch controls (TACs)
vi. Secure Access controls (Licenses)
vii. Secure Rights to specific share of catch
viii. Secure Rights to space
ix. Secure Rights to effort

*Market Measures*

x. Royalties, Access Charges, etc
xi. Pricing
xii. Demand modification (eco-certification)
xiii. Supply modification (sanctions – Convention on International Trade in Endangered Species (CITES), International Commission for the Conservation of Atlantic Tunas (ICCAT)

The analysis proceeded by tabulating the consequences of specific classes of management measures when applied to address single Factors of Unsustainability in specific geographic strata. In principle, these tabulations should be done for all combinations of the 15 classes of management measures with the five geographic strata. However, it was noted that for some measures the results of evaluations may be the same for multiple strata, or that the evaluation of some classes of measures may turn out to be identical for all areas. If that is the case the problem has been over-identified in some sense, and some of the classes of measures could be combined.

In completing the table, each measure was evaluated relative to the baseline condition of *No Management*. The results of the tabulation indicated that under *No Management*, most of the factors of unsustainability could be serious. The Working Group then entered into the table each class of management measure that it thought might be proposed to address the "initial factor" (in the table heading).

For the factor, the evaluation presented the expected effect of the measure on ecological sustainability (E), economic sustainability (W - 'wealth'), and community sustainability (C). The effect could be negligible (-), moderate (e,w,c) or very large (E,W,C). In some cases the effect would be to *increase* unsustainability on that dimension rather than decrease it, and in those cases the entry is *italicized.*

The Working Group next tabulated what other factors of unsustainability would be likely to be intensified or introduced in response to implementing the initial measure effectively. These were often numerous. In some cases the consequences were expected to be so likely and so severe that the resultant situation was expected to be worse rather than better. These are designated in the Comments Section with the sign: **bold*****.**

After the consequences of each measure were evaluated individually, the working group identified a few combinations of measures that were thought likely to be implemented together in efforts to improve sustainability. The consequences of these measures, in combination, were evaluated in the same way as described for the single measures. There was no attempt to explore all possible combinations of management measures, but it would be a valuable result of this evaluation framework, if it were possible to identify the combination of measures that would result in the fewest new factors of unsustainability. In a similar vein, although this evaluation used the *No Management* condition as the baseline, the baseline could equally be some existing (or proposed) set of management measures. Against that baseline the effects of additional measures would be evaluated directly.

In the time available it was possible to complete the evaluation exercise for one combination of an initial factor of unsustainability, in one stratum, and partially complete a second combination. The results are presented in Tables 1 and 2.

**Table 1: External factors of increasing demand, for fishery in 0-3 mile stratum**

| Measures to address | Impact on dimension | New Factors Possible | Comments |
|---|---|---|---|
| ii<br>Technical measures | E, wW, cC | 4,8,9,15, 14 | wW cC depends on whether measure decreases efficiency or increases yield<br>9 – may not create but could make worse<br>14 if it shifts equilibrium |
| iii<br>Closed areas | -E, *w*w, *C*c | 5,8,9,13, 14 | -E –depends on biology & closure<br>*w*w – Redistribution of effort is very likely to dissipate any benefits<br>*C*c – size & site of area closed is crucial<br>**9 - *** |
| iv<br>Effort control | e, w,- | 4,8, 9 | **9 - *** |
| v<br>Catch control | E, -w, c | 4,8,11,15 | **4 - ***<br>**8 - ***<br>11 – Little ability to provide science at this spatial scale.<br>**15 - *** |
| vi<br>Licence | -e, w, *c*c | 4,5,8,15 | e if limited enough to be same as 5.<br>.*c* if the licences are so few that large inequities result |
| vii<br>ITQ | eE, W *C*C | 5, 8, 14, 15 | *C*C depends on equity of implementation & system<br>**8 -*** |

| | | | |
|---|---|---|---|
| viii<br>Territorial rights | eE, wW, *c*c | 1,4,5,8, | *c*c (see 7)<br>eE &1 effectiveness as incentive depends on biology<br>4 – If the target species is mobile<br>.*c*c (see 3)<br>Promotes anti-15 |
| ix<br>Effort quota | eE, wW, *c*c | 4,8,9 | *c*c (see 7) |
| x<br>Royalties | eE, wW, *C*C | 1,8,13, | *C*C – depends on what is done with royalties.<br>8 – Compliance may not be welcoming, esp. at implementation, so needs high commitment to 10 |
| xi<br>Pricing | same as 10 here | | |
| xii<br>Demand modification | eE, *W*w, *C*c | 2,5,8,10, | Almost necessarily will occur with other measures (necessary for certification).<br>*WC* is possible because cost of obtaining certification excludes poorer regions |
| xiii<br>Supply modif. | eE, *W C* | 8 | |
| ii,iii,v,vi | eE, -w, *c*c | 4,8,9,11, 15 | *c* is particularly important when there is low opportunity cost.<br>Common approach in many fisheries<br>**8 - ***** |
| ii,iii,v,vi,vii,x | eE, wW, *C*c | 8,11,15 | This is common IQ system with some transferability.<br>*C* - Stability of mgmt system requires equity of distribution of benefits.<br>**8 - ***** |

**Table 2: Lack of incentives for conservation in high seas (partial analysis only)**

| | | | |
|---|---|---|---|
| iii | eE, - , - | 3,11 | |
| v | -E, -, - | 3,11 | |
| vi | -e, -w, - | 3,11 | |
| vii | -e, wW, - | 3,11 | |
| viii | -E, W, - | 3,11 | |
| x | -e, W, - | 3,11 | |
| xii | eE, wW, - | 3,11 | |
| xiii | -E, *W*,- | 3, | |
| ii,v,vi | eE, w,- | 3,11 | |
| ii,iii,viii | eE, wW, - | 3,11 | |

# 4. SUMMARY REPORT OF WORKING GROUP 2

## Discussion on unsustainability

Sustainability in a fishery context implies sustainability of the use of the resource by humans, and so it includes economic and social dimensions as well as the ecological dimension.

Sustainability of a fishery as a whole requires simultaneous sustainability on the ecological, economic and social dimensions. A fishery is not described as sustainable if it is unsustainable on any of these dimensions, because unsustainability in any one could later cause unsustainability in the others.

Sustainability of a fishery should be judged in terms of the contribution of the fishery to national sustainable development, and not just the interests of the fishery sector.

## Definition of unsustainability

Unsustainability occurs in a fishery system when it is agreed that there is an unacceptably high risk that the fishery system is currently or will be in some predefined undesirable state. The risk may be aggravated by natural variability. Desirable states, in terms of both human and ecosystem well-being, are defined by society and may change over time. [1]

Unsustainability encompasses:

(1) Acute unsustainability (i.e. collapse of the resource or of the fishery with catches well below what might otherwise be available and recovery may be difficult, slow or impossible);

(2) Chronic unsustainability (i.e. resource reduced to the point where catches are lower than they might otherwise be, even if these low catches might be maintainable indefinitely); and

(3) Incipient unsustainability (i.e. if present practices are continued there is an unacceptable risk that the resource will become acutely or chronically unsustainable).

## Unsustainability factors

Group II identified unsustainability factors in the context of the Pressure State Response (PSR) framework[2]. More than one hundred factors were identified but some appeared several times under different names, even in the same component of the Pressure State Response framework. A consolidated list avoiding repetitions is provided in Annex 1.

The main headings were:

- Social (Demographics – Poverty – Social system)
- Economics (Markets, Technology – Innovations)
- Bio-ecological (Climate, environment)

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[1] For example the UN Convention on the Law of the Sea in 1982 referred to MSY while the UN Fish Stock Agreement in 1995 considers MSY to be a limit reference point to be avoided.

[2] The framework is described for example in: 'Indicators for sustainable development of marine capture fisheries'. FAO Technical Guidelines for Responsible Fisheries No 8. Rome, FAO, 1999.

- Management institutions (Governance, Industry).

Participants were asked to identify the three most important factors of unsustainability for each component of the Pressure State Response framework and the scores were calculated by weighing individual scores by the rank (1 for 1, 0.5 for 2 and 0.3 for rank 3) and the results are shown in Annex 2.

The factors of unsustainability in the Pressure component of the PSR framework are largely economic (excess fishing capacity, asymmetric entry/exit, market pressures, absence of long term view) and social (no alternative livelihoods, demographic pressures, and poverty). Unsustainability also arises from management and institutional aspects (ineffective and no conflict resolutions). Climatic changes, uncertainty and variability in resources are factors of unsustainability in the bio-ecological dimension.

Under the State component of the PSR framework, the main factors of unsustainability are related to the management and institution (ineffective institutions, insufficient monitoring, control and surveillance, insufficient information for decision making and implementation, unclear access conditions, absence of rights, etc.) and to the economic aspects of the fishery system (technological innovations, overcapacity, subsidies, illegal financial transfers). The bio-ecological factors of unsustainability (stock status, uncertainty, variability, fragility) and the social factors (low public awareness, equity issues) are relatively less important.

Under the Response component of the PSR framework, the main factors of unsustainability are related to the management and institutions (ineffective management, undefined rights, inappropriate response from the sector) and social (low public awareness, inadequate organization of the sector). Market responses may be a factor of unsustainability under the economics component of the fishery system. No bio-ecological factors of unsustainability were identified in the Response component, but in the discussion it was noted that uncertainty often undermines management.

The main factors of unsustainability, in the Pressure State Response framework are summarized in Table 3.

**Dynamics of unsustainability under four management scenarios**

*Unsustainability dynamics without management*

There are several reasons why fisheries management may not be in place. In early stages of the fishery the reason may be that no problems emerged which may have called for management. However, the more typical situation is that management institutions are weak. The institutions may lack capacity to produce the knowledge required, to resolve conflicts and have decisions made or to implement management measures through monitoring, control and surveillance or other law enforcement measures. Such weaknesses may apply both to individual partners in management (government, fishing industry and communities, other interested parties) and to the institutions through which they interact.

Several driving forces may motivate people and capital to move into the fisheries sector. Markets, available fisheries resources and technological opportunities may enable investments in the sector to produce a profit which is above the expected profit for alternative investment opportunities. Likewise, poverty or low incomes in other sectors may be such that labour expects to be able to produce a higher income in the fisheries sector than elsewhere, whether in kind or in cash.

## Table 3: Key factors of unsustainability

| The table has been constructed vertically, i.e. factors of unsustainability in the social, economic, bio-ecological and institutional components were listed under Driving Force, Pressure, State, and Response. Sometimes, a horizontal relationship exists but this is accidental. | | | | |
|---|---|---|---|---|
| **Social** | **Driving Force** | **Pressure** | **State** | **Response/ Governance** |
| | • Population growth, migration and poverty | • Lack of alternative sources of income | • Overcrowding of the sector cause conflicts<br>• Dependence on social welfare | • Low public awareness allows unsustainability and irresponsible fisheries to occur<br>• Inadequate organization of the sector |
| **Economics** | • Markets forces, particularly through globalization, making fisheries relative income higher than alternate activities cause increased exploitation either through new entries in the fishery or increased efficiency of existing units | • Profitability - return on capital over and above what is needed to pay capital costs and labour income above what they would get in other occupations (no user costs)<br>• Technological innovations leading to increased exploitation rates and overcapacity | • Overcapacity: fishing units (gear or people) in a given fishery exceeds the productive capacity of the resource | • Industry adaptation (reaction different than that expected), new fisheries and new areas<br>• Short-term vs. long-term |
| **Bio-ecological** | • Climate and environmental changes | • Variability and uncertainties in resources | • Uncertainty in present and future state<br>• Environmental damage<br>• Resource depletion, increased risks of collapse | • Uncertainty undermines management |
| **Institutions** | • Insufficient human and financial resources for management and for the implementation of international instruments<br>• Insufficient political will | • High demands for the resources create conflicts between user groups, interested parties, institutions | • Weak institutions in knowledge production, weak enforcement, decision-making and conflict resolution<br>• Inability or unwillingness to implement existing instruments | • Weak institutions producing insufficient and inadequate knowledge, inappropriate manage-ment response, insufficient enforcement, absence of rights (not necessarily catch), ill targeted management<br>• Incentives in the wrong direction |

These higher relative returns in the sector will, if there is no management, put pressure on the sector by attracting capital and labour into the fisheries. This increase in capacity results in higher exploitation of the resource that leads to a reduction in the resource biomass. In terms of economics this results in lower catches relative to the invested capital and applied labour, and thus lower returns. As a side effect, increased capacity will lead to increased environmental impacts in terms of by-catches and impacts on the habitat. Furthermore, as the resource is being more exploited, uncertainties about its state and productivity may increase and environmental variability will result in larger variability.

Lower returns will motivate the fisheries to compensate by expanding the market (expanding market volume, finding higher value markets), reducing relative costs through technological innovation or to expand the resource base by exploiting other resources. If such means are effective in maintaining relative returns above what is expected in other sectors, the influx of capital and labour is expected to continue. The results of this process will, if unchecked, result in recruitment-overfishing that eventually may lead to the stock being depleted or even collapse. In this process, the relative economic returns will become so low that the industry basically is unviable. This will create conflicts among users and increased motivations for bad practices.

Alternative income sources for specialized labour may not be available and investments are locked in vessels with a long investment horizon. The situation may therefore be that labour and capital remain for a long time in the fisheries even at relative rates of return which are considerably lower than returns in other sectors. This lack of exit options perpetuates and aggravates the overexploitation and the deterioration of the economy of the sector.

*Small-scale fishery*

The group first identified the small-scale fishery situation to be examined, recognizing that there are very many types of small-scale fisheries. The situation selected was of a small-scale fishery that was typically:

- Vessels less than five GT, multispecies, multigear, mechanized (to the level of outboard motors), coastal market oriented, and will loosely organize fishery participants;
- Potentially controlled by limited entry of participants by area.

A variation was consideration of medium scale fisheries with the same characteristics except that the fishery involved slightly large and more mechanized vessels that could utilize both coastal resources and those further offshore.

The group identified the typical Driving Forces, Pressures and States in the social, institutional, economic and ecological dimensions for this type of fishery. The group then identified the human responses necessary to enable limited entry management of the fishery to achieve sustainability. So the driving forces, pressures and states were based on experience with existing fisheries of this type, while the response relates to an imagined situation that would enable limited entry management of the small-scale fishery.

The group then constructed flow charts relating the Pressures, States and Responses, so as to illustrate the management intervention points and the effect of successful/unsuccessful intervention on the pressures and states. This was complex in the situation with small-scale fisheries, particularly because most small-scale fisheries are not presently managed by access limitation and the complexity of establishing the institutional and management arrangements

to enable effective management of access limitation. Because of this complexity, the group developed two flow charts – one an overview of the system as a whole, using a structure similar to that developed for the case of "no management" (Figure 2), and the other giving additional detail about the establishment and operation of the institutional structures and arrangements (Figure 3).

**Figure 1: Dynamics of unsustainability under NO MANAGEMENT option**

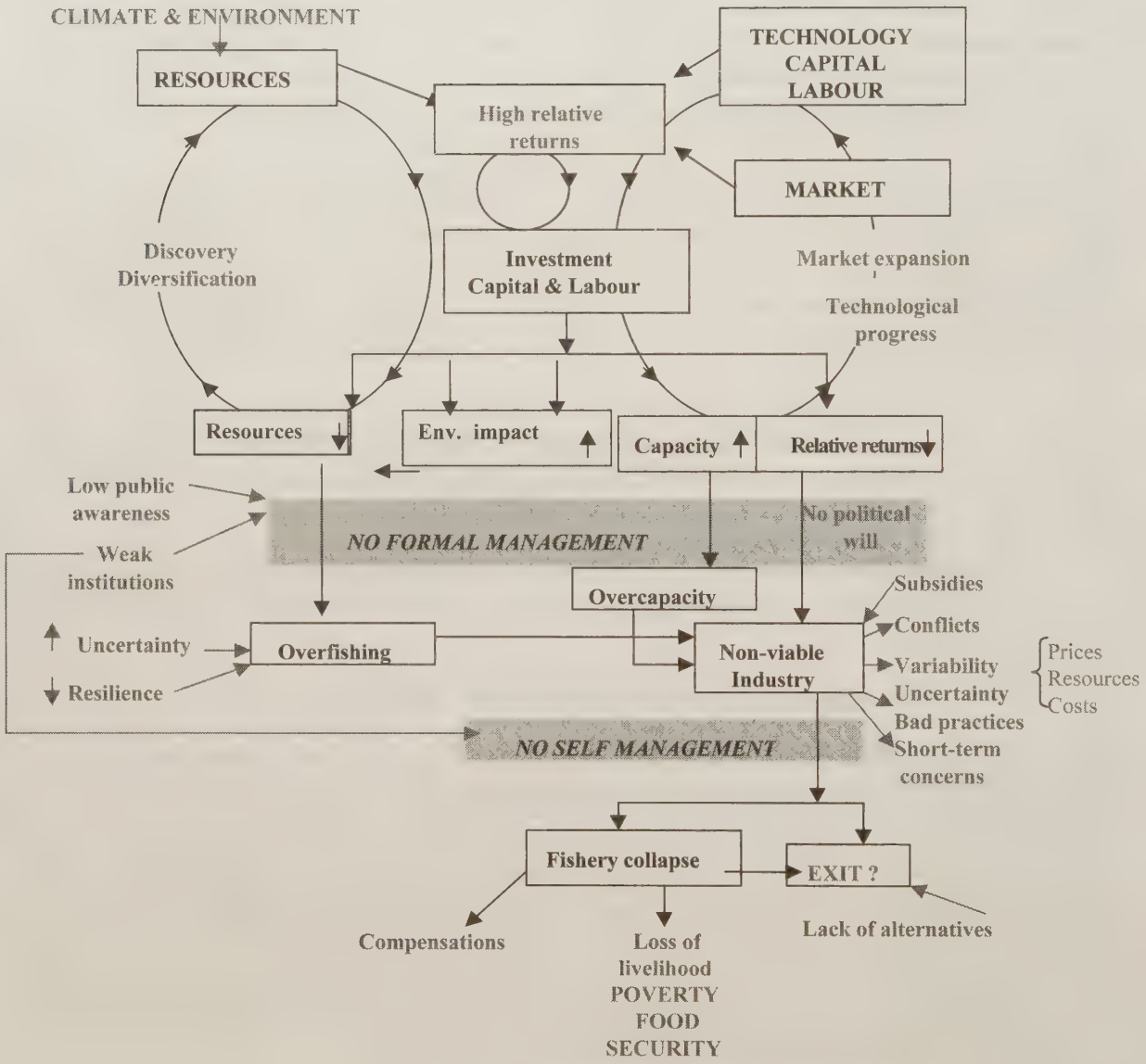


**Figure 2: Pressure – State – Response for small-scale fisheries**

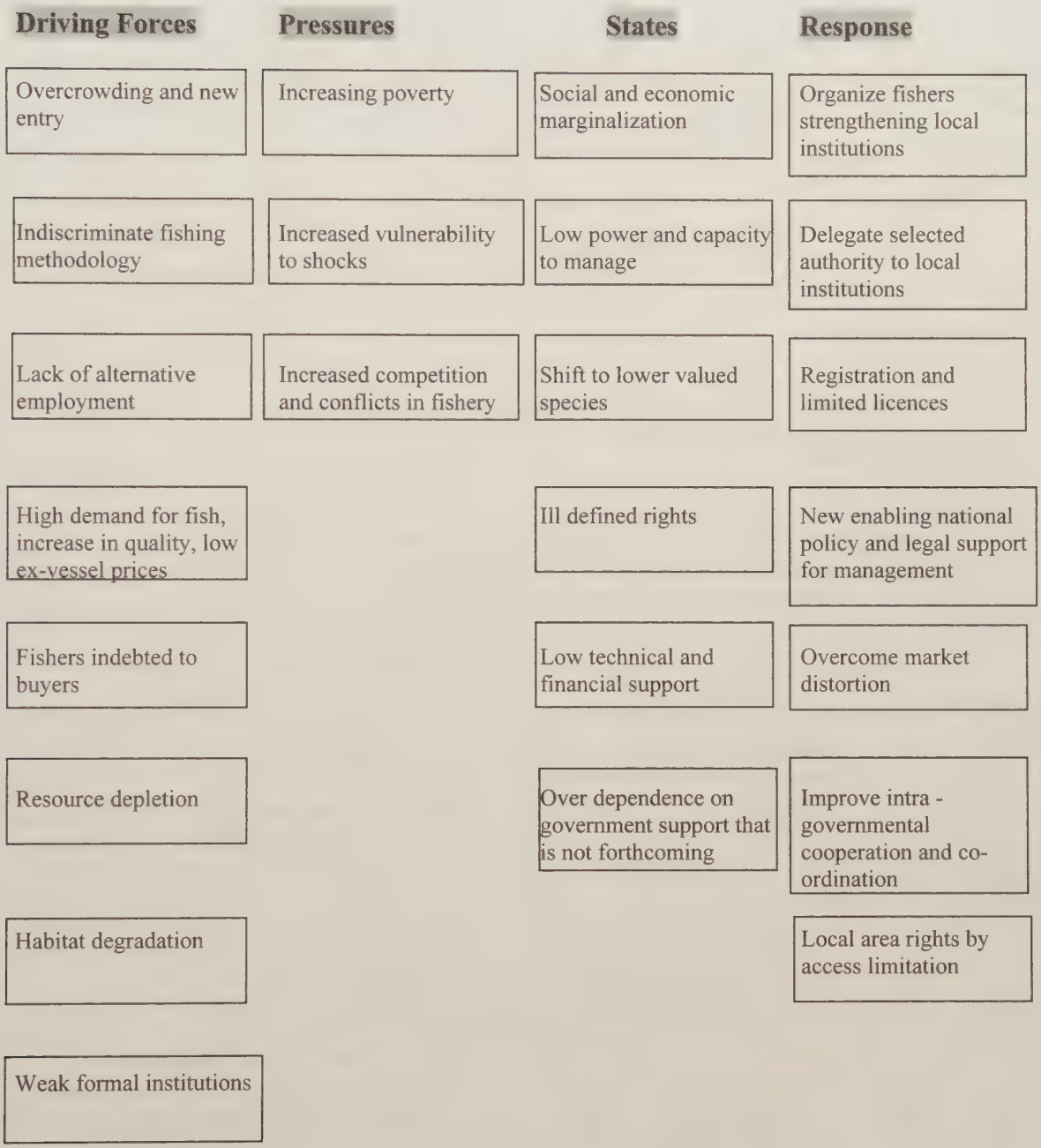

Driving Forces
Pressures
States
Response
Overcrowding and new entry
Increasing poverty
Social and economic marginalization
Organize fishers strengthening local institutions
Indiscriminate fishing methodology
Increased vulnerability to shocks
Low power and capacity to manage
Delegate selected authority to local institutions
Lack of alternative employment
Increased competition and conflicts in fishery
Shift to lower valued species
Registration and limited licences
High demand for fish, increase in quality, low ex-vessel prices
Ill defined rights
New enabling national policy and legal support for management
Fishers indebted to buyers
Low technical and financial support
Overcome market distortion
Resource depletion
Over dependence on government support that is not forthcoming
Improve intra - governmental cooperation and co-ordination
Habitat degradation
Local area rights by access limitation
Weak formal institutions

**Figure 3: Overall or 'macro' flow chart on the management of small-scale fisheries.**

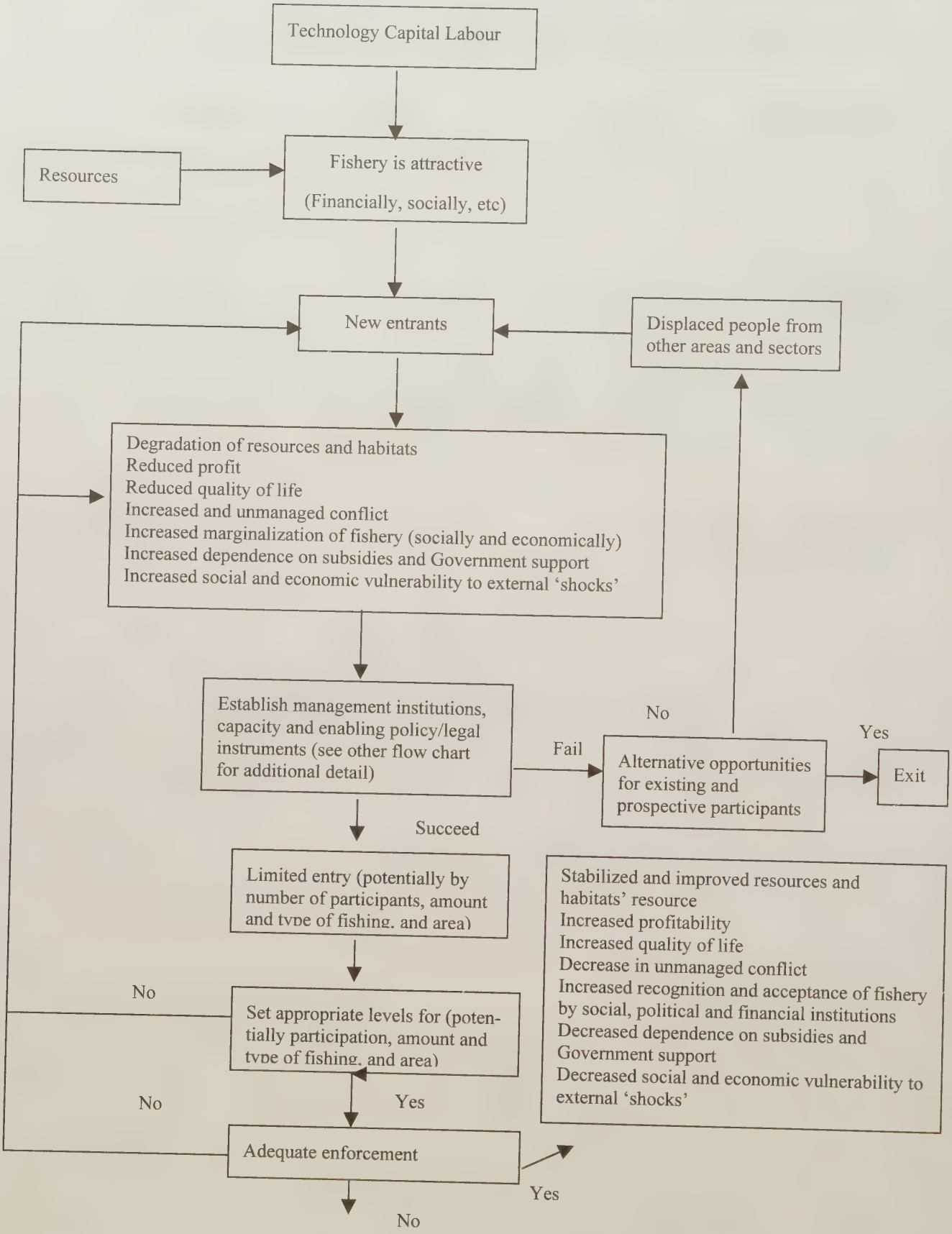
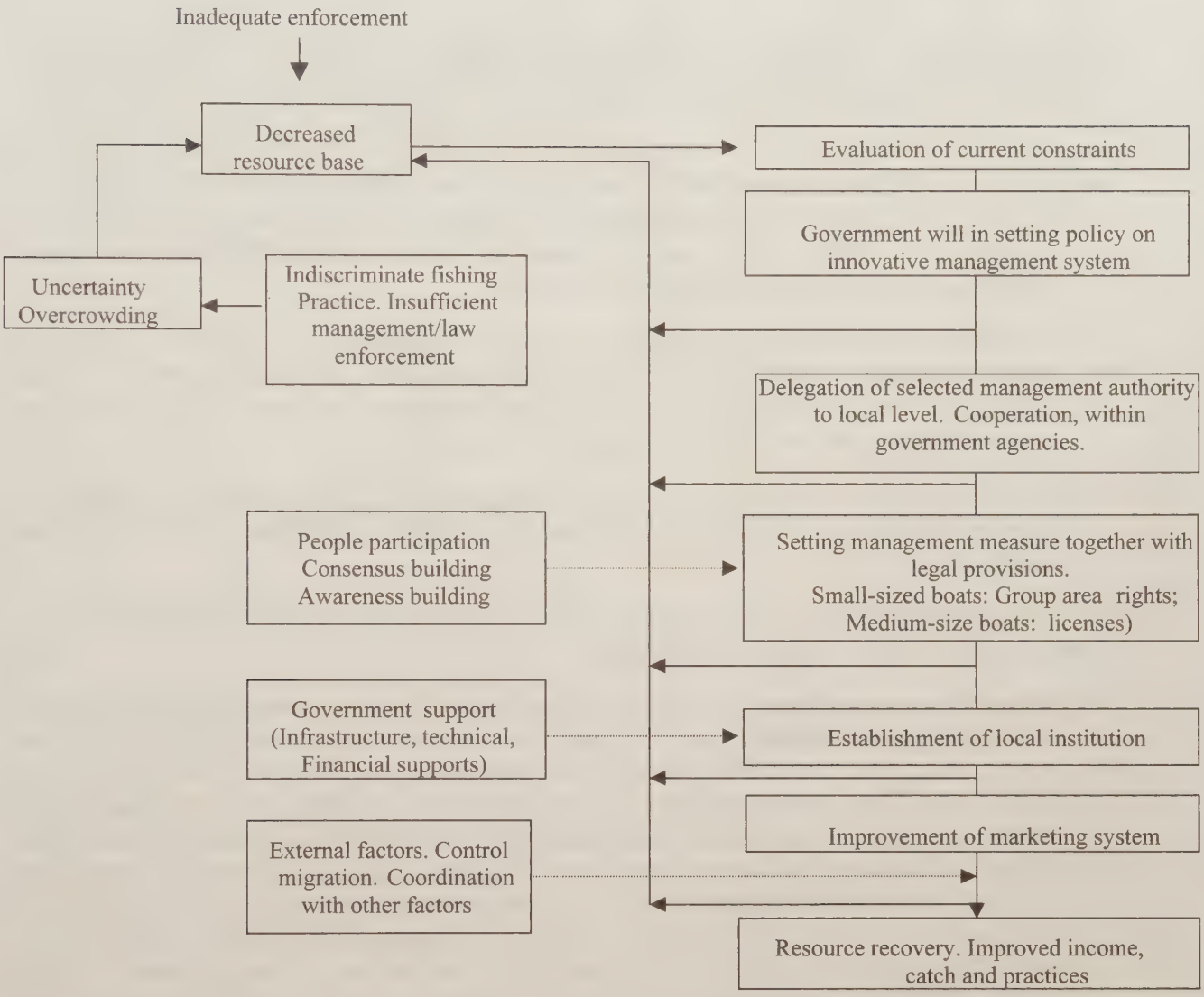

Technology Capital Labour
Resources
Fishery is attractive
(Financially, socially, etc)
New entrants
Displaced people from other areas and sectors
Degradation of resources and habitats
Reduced profit
Reduced quality of life
Increased and unmanaged conflict
Increased marginalization of fishery (socially and economically)
Increased dependence on subsidies and Government support
Increased social and economic vulnerability to external 'shocks'
Establish management institutions, capacity and enabling policy/legal instruments (see other flow chart for additional detail)
Fail
No
Yes
Alternative opportunities for existing and prospective participants
Exit
Succeed
Limited entry (potentially by number of participants, amount and type of fishing, and area)
Stabilized and improved resources and habitats' resource
Increased profitability
Increased quality of life
Decrease in unmanaged conflict
Increased recognition and acceptance of fishery by social, political and financial institutions
Decreased dependence on subsidies and Government support
Decreased social and economic vulnerability to external 'shocks'
No
Set appropriate levels for (potentially participation, amount and type of fishing, and area)
No
Yes
Adequate enforcement
Yes
No

**Figure 3 ( cont'd)**


Inadequate enforcement
Decreased resource base
Evaluation of current constraints
Government will in setting policy on innovative management system
Uncertainty Overcrowding
Indiscriminate fishing Practice. Insufficient management/law enforcement
Delegation of selected management authority to local level. Cooperation, within government agencies.
People participation Consensus building Awareness building
Setting management measure together with legal provisions. Small-sized boats: Group area rights; Medium-size boats: licenses)
Government support (Infrastructure, technical, Financial supports)
Establishment of local institution
Improvement of marketing system
External factors. Control migration. Coordination with other factors
Resource recovery. Improved income, catch and practices

***Large-scale (industrial) fisheries- Single species TAC-based management system with limited or open access***

In this scenario the fisheries are controlled by an overall catch quota, the so-called total allowable catch (TAC). This is set for the entire stock, even though stocks may be shared by different countries, in which case the TAC would be divided between them. The TAC may or may not be divided between the participants in the fishery, while the fleet capacity may or may not be controlled. We distinguish between three scenarios:

1. There is no division of the catch between the vessels and there is no control over the fleet capacity or its effort. This scenario is therefore essentially one of open access to the fishery and a competition for a given total catch.

2. The fleet is controlled by licensing fishing vessels but there is no or imperfect control of effort and probably no division of the catch between the boats. The competition for the total catch would be limited by the given number of vessels, but technological improvements would nevertheless increase fleet capacity over time.

3. The fleet and its effort are controlled in a near-optimal way. This could, for example, be done by dividing the total catch between the vessels, controlling days at sea, gear specification, etc.

The overall scenario starts with abundant resources and high profitability in the fishery. The dynamics for the three scenarios are different.

1. If there is no control over effort or fleet capacity, there will be investment in new fishing vessels, or improvements of old ones, until profits in the fishery have fallen to or even below a break-even level where capital costs are just recovered. There will be pressure to increase the TAC and irresponsible fishing practices, including non-compliance, may become prevalent. What happens next depends on how resilient the management is, inter alia its confidence in the advice being given about the status of stocks and the appropriate TAC and its capacity to control catches. If management continuously yields to pressure, the resource will be depleted, resulting in a reduced fishery and possibly a collapse of the stock. To remedy this situation would require an improvement in management, resulting in an improved resource status and a return to higher levels of catches but, in economic terms, nothing would be gained as long as there is no control of fleet and effort.

2. If within the TAC system there is control over the fleet by licenses, with limited control over effort, technological progress (including learning) will result in a gradual build-up of overcapacity. This will encourage irresponsible fishing practices and pressure towards increasing the TAC. The outcome from there on would be similar to the previous scenario.

3. If there is effective control over fleet capacity and effort, as well as effective monitoring, control and surveillance, responsible fishing should take place. There may nevertheless be pressure to increase the TAC for reasons of profitability, absence of long term rights in the fishery, etc. This pressure may or may not be successful and the development of the fishery would be similar to the ones described above.

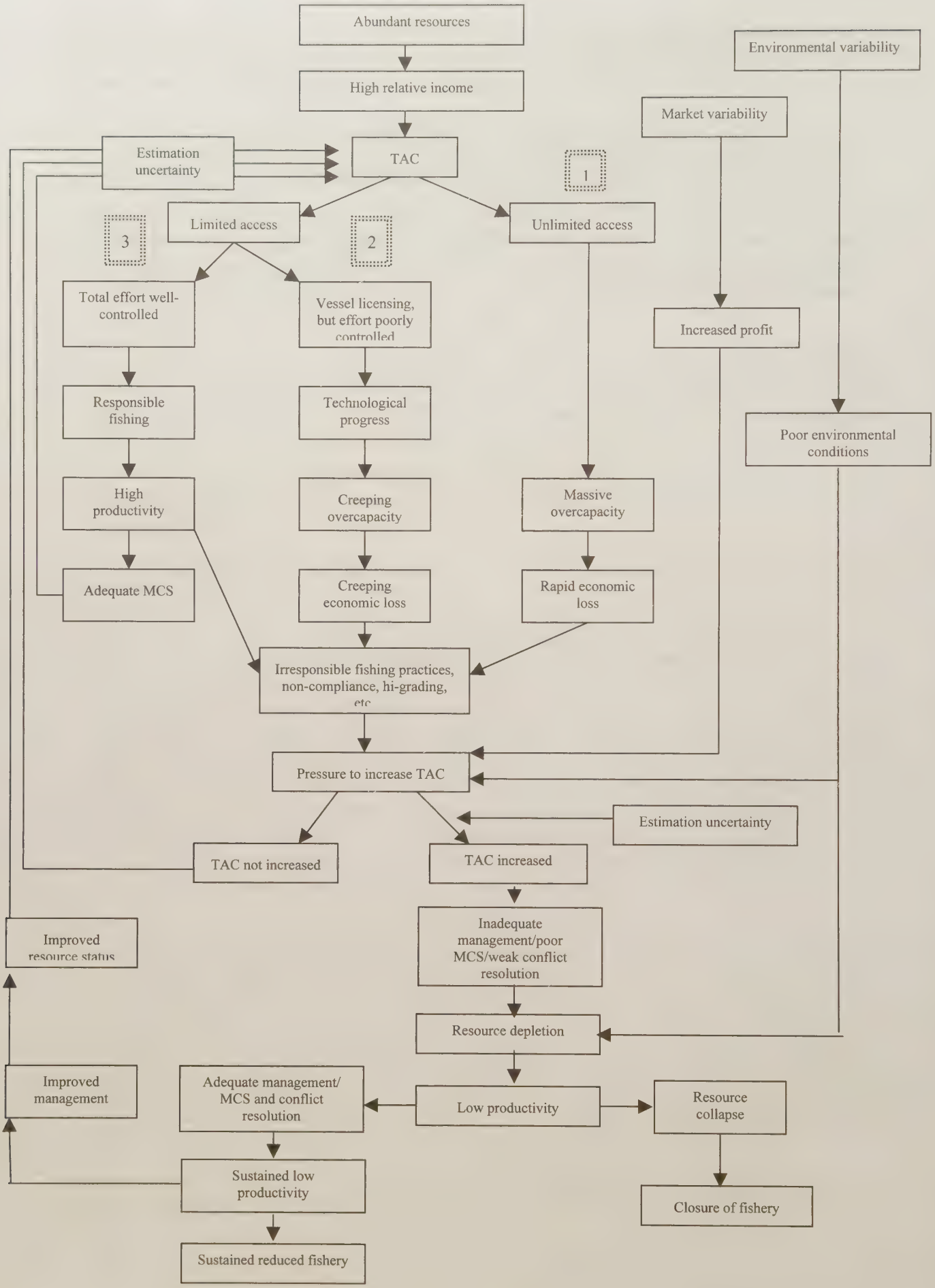
Uncertainty and variability of various kinds may complicate these scenarios and jeopardize the implementation of management measures.

1. Uncertainty in estimation of the resource may lead to an erroneously set TAC and threaten the productivity of the stock. This is particularly important when there is pressure to raise the TAC, as this uncertainty may cause managers not to take the appropriate measures.

2. Environmental variability, especially if it is unforeseen, may impact the viability of the resource. It may be difficult to reduce the TAC during less productive periods because of resistance from the industry which would be further exacerbated in the event of overcapacity and absence of long-term rights.

3. Market variability, i.e. fluctuations in prices, will have many of the same consequences as environmental variability. In addition, it might occasionally lead the industry to make over-optimistic price forecasts.

## Figure 4: Large-scale (industrial) fisheries



# ANNEX 1

# UNSUSTAINABILITY FACTORS IN A PSR FRAMEWORK

## A. PRESSURE

***Social (Demographics – Poverty – Social system)***

Demographic social pressures result from people migrating to the coast for several reasons including drought, war, and epidemics. The migrants going to the coast are poor and fishing is often an employer of last resort in the absence of alternative livelihoods. Social pressure also arises from coastal development for tourism. Increased coastal population and increased tourism are in direct conflict with the fisheries activity traditionally carried on in the coast area.

Social pressure also arises from the perceived lack of equity of certain management systems.

Social pressures may also arise because of food insecurity and unsafety due to pollution or contamination.

***Economics (Markets – Technology – Innovations)***

Globalization causes pressure on the market for seafood, on capital and on labour and free trade, particularly in the absence of management, can cause severe pressure for increased exploitation. Profitability at the early stages of a fishery attracts either new entrants or new capital leading to overcapacity and eventually to overexploitation. This problem is compounded by capacity inertia and asymmetric entry/exit whereby it is easier to get in the fishery than to get out of it. New entrants may also be attracted because the wages into the fishery sector are higher than in other sectors. Subsidies can cause increase in profitability.

Market and economic forces may create pressures for irresponsible fishing such as exploitation of juveniles and destructive practices.

De-coupling of pricing policies from the status of resources;

Other problems involve misguided aid from donor agencies, particularly from development banks searching outlets for their loans.

The proliferation of international instruments has the unfortunate side effect that none can be implemented completely because of pressure to implement the most recent one.

Lack of incentive to protect the resources due to inappropriate trade-offs between short-term obligations and long-term objectives, causes major pressures on the bio-ecological and management systems. This applies to individuals, to companies and to governments. The inappropriate trade-offs are partially due to variability and uncertainties in the future status of the resource and in future management decisions.

***Bio-ecological (Climate –Environment)***

Bio-ecological pressures arise from the possible effect of fossil fuel emissions on climate change and from shifts in environmental regimes.

***Management institutions***

Pressures in the management and institutions component are generated by competition between user groups, interested parties and between the institutions themselves (fishery management ministry in competition with environmental ministry or tourism ministry). The nature of fishery management, whereby new legislation and regulations are often added to existing ones results in apparent over-regulation and accumulation of management regimes. With the implementation of the Precautionary and Ecosystem approaches, the management institutions are submitted to and create pressures for the integration of environmental concerns in their activities, in addition to their more traditional activities. Electoral cycles also create pressures.

## B. STATE

***Social system***

In most fishery management processes, very few of the interested parties, including the management authorities themselves, have training in resource conservation or in responsible fisheries. This state of the social system makes it difficult to resist pressures to increase exploitation and is therefore a factor of unsustainability. Similarly, a state of low public awareness of conservation and responsible practices issues is a factor of unsustainability. A state of low mobility of people implies that overexploitation is difficult to reverse once it is reached. A state of poor communications between fishers and governments, and vice-versa, impedes efficient fishery management and is therefore a factor of unsustainability. A state of conflict and/or inequity would obviously be a factor of unsustainability, as would low wealth of society which would impede effective fishery management.

Food security;

Food safety (pollution);

***Economics***

A state of overcapacity is one of the main factors of unsustainability. It may result from early profitability leading to dimensioning the sector to the peaks of production combined with asymmetric entry/exit (capital inertia, low mobility and flexibility outside of the fishery sector), subsidies, and input substitution. Overcapacity may lead to irresponsible fishing practices. Uncertainty of future outcomes leads to focussing on short-term results (investment horizon) instead of long term objectives.

Too specialized fisheries;

Management costs not covered;

Research investment;

***Bio – ecological***

Status with respect to reference points;

Resilience;

Scale;

Variability;

Management unit vs. biological unit;

Shared stocks;

Degradation of habitat;

Pollution;

Variability;

Climate change;

***Management institutions***

Access conditions;

Over-regulation;

Rights;

Race for rights (entitlements);

Organization of the sector/interested parties;

Fishing regime;

Multiple institutions, competition, lack of cooperation;

Delegation/command control vs bottom up;

Lack of partnership;

Monitoring, control and surveillance and law enforcement;

IUU fishing;

Flags of convenience;

Information/statistics/knowledge (including the fisheries system as a whole, not only the resource system);

Accountability;

Illegal financial transfers (lack of transparency);

Adaptivity;

Cost of management (relative to norms (international instruments) and scale of fishery);

## C. RESPONSE

***Social***

Consumers (eco-labelling)

Public awareness

***Economics***

Profitability

Organization of the sector

Incentive for long-term conservation

Race to fish

Safety on board

Misreporting – high grading – discarding

Flags of convenience

Adaptability and mobility

***Management***

Rights

Ill targeted management (too weak or too strong, including no response)

Decentralization – devolution – participatory governance

Accountability

Information – knowledge – statistics

ICAM

Monitoring control and surveillance

Singles species management

Institutional memory

Performance assessment

Incongruent scales

Subsidies

Incompetence

Flexibility (rigid management)

Risk management (prevention, insurance, better able to cope)

Short-term fix by adopting new law/regulation

Conflict resolution mechanism

Resource rent (value of resource in the water)

## APPENDIX 2

## RANKING OF THE UNSUSTAINABILITY FACTORS

| PRESSURE | Score | Total |
|---|---|---|
| **Social** | | |
| No alternative livelihood – last resort | 4.5 | |
| Demographics | 2.1 | |
| Poverty | 1.5 | |
| Food safety | 0.5 | |
| | | **8.6** |
| **Economics** | | |
| Excess fishing capacity – asymmetric entry- exit | 4.3 | |
| Markets/economy | 2.5 | |
| Short-term/long-term | 2 | |
| Free trade (if no management in place) | 1 | |
| Technology/innovation | 0.8 | |
| Market practices (juveniles) | 0.5 | |
| Globalization | 0.5 | |
| Subsidies (not always bad) | 0.3 | |
| Interest rates – input costs | 0.3 | |
| Destructive fishing practice | 0.3 | |
| | | **12.5** |
| **Bio-ecological** | | |
| Variability and uncertainties of future status of resource and management | 1 | |
| Climate environment | 1 | |
| | | **2** |
| **Management institutions** | 3.1 | |
| Competition between user groups, interested parties, institutions | 0.6 | |
| | | **3.7** |

| STATE | Score | |
|---|---|---|
| **Social** | | |
| Public awareness | 0.5 | |
| Food safety (pollution) | 0.5 | |
| Equity | 0.3 | |
| Wealth of society | 0.3 | |
| | | **1.6** |
| **Economics** | | |
| Technology | 2.3 | |
| Economic system | 2.1 | |
| Overcapacity | 1.8 | |
| Subsidies | 1 | |
| Profitability | 0.5 | |
| Management costs not covered | 0.3 | |
| Illegal financial transfers (lack of transparency) | 0.3 | |
| | | **8.3** |
| **Bio-ecological** | | |
| Status with respect to reference points | 1.8 | |
| Uncertainty | 1.8 | |
| Resource system | 1.3 | |
| Variability | 0.5 | |
| Resilience | 0 | |
| | | **5.4** |
| **Management institutions** | | |
| Management institutions/governance/legal | 4 | |
| Monitoring, control and surveillance and law enforcement | 1.5 | |
| Information/statistics/knowledge (including the fisheries system as a whole, not only the resource system) | 1.3 | |
| Access conditions | 1 | |
| Rights | 1 | |
| Organization of the sector/interested parties | 1 | |

| | | |
|---|---|---|
| Management unit vs. biological unit | 0.5 | |
| Multiple institutions, competition, lack of cooperation | 0.5 | |
| Cost of management (relative to norms (international instruments) and scale of fishery) | 0.5 | |
| Scale | 0.3 | |
| Fishing regime | 0.3 | |
| | | **11.9** |

| **RESPONSE** | **Score** | |
|---|---|---|
| **Social** | | |
| Public awareness | 1.8 | |
| Society | 1.4 | |
| Organization of the sector | 1.3 | |
| Consumers (eco-labeling) | 0.3 | |
| | | **4.8** |
| **Economics** | | |
| Markets | 1 | |
| Race to fish | 0.5 | |
| | | **1.5** |
| **Bio-ecological** | | |
| **Management institutions** | | |
| Management | 5.5 | |
| Rights | 4 | |
| Ill targeted management (too weak or too strong, including no response) | 2.3 | |
| Industry | 2.1 | |
| Monitoring control and surveillance | 1 | |
| Flexibility (rigid management) | 1 | |
| Decentralization – devolution – participatory governance | 0.5 | |
| Singles species management | 0.5 | |

| | | |
|---|---|---|
| Information – knowledge – statistics | 0.3 | |
| Incongruent scales | 0.3 | |
| Conflict resolution mechanism | 0.3 | |
| Incentive for long-term conservation | 0.3 | |
| | | **18.1** |

## 5. CONCLUSIONS AND RECOMMENDATIONS ON FACTORS OF UNSUSTAINABILITY AND FISHERIES MANAGEMENT

Conclusions and recommendations were discussed in plenary session, based on an analysis of reports prepared by the two working groups. The following conclusions and recommendations were adopted by the Workshop.

### Conclusions on factors of unsustainability and overexploitation

Several factors of unsustainability have been identified by the two working groups. Some are internal to fisheries, others can be considered external. Some contribute directly to unsustainability, others are symptoms. Factors play different roles at various stages of the fishery management process and under different jurisdictions. Factors contributing to unsustainability are of a similar nature in almost all fishery systems and jurisdictions, if on a different scale and with a variable degree of importance.

In developing its recommendations, the Workshop noted that the factors of unsustainability could be grouped into six general types of pressures. Recommendations are offered further on in this section to address each type of factors. The types of factors are:

- Inappropriate incentives, including market distortions: Currently, many fisheries operate in response to incentives (economic and others) that promote unsustainable practices rather than sustainable ones.

- High demand for limited resources: Demand for fish is seen as expanding for most markets, with sustainable supply becoming increasingly limited. Higher prices may result which provide an incentive for further input expansion – generally more so in fisheries that are already overexploited.

- Poverty and lack of alternatives: Conditions of poverty and lack of employment or livelihood alternatives still occur on a significant scale, particularly but not only, in developing countries.

- Complexity and inadequate knowledge (social, economic, bio-ecological): The complexity of many fisheries systems as well as inadequate information and understanding make it hard to identify proper courses of action.

- Lack of governance: (conflicting objectives, lack of attention, will and authority): The inability to implement required management measures by legitimate authorities (including the absence of appropriate institutions) contributes to unsustainability.

- Interactions of the fishery sector with other sectors, and the environment: These factors are in most cases beyond the control of the fisheries sector but need to be better accounted for.

The Workshop also identified seven types of measures that could be taken to address the factors of unsustainability listed above. These are not presented as solutions, but as steps towards sustainability.

- Rights: The granting of secure rights to resource users (individually or collectively) for use of a portion of the catch, space, or other relevant aspects of the fishery.

- Transparent, participatory, management: The granting of a meaningful role to stakeholders in the full range of management (e.g. planning, science, legislation, implementation).

- Support to science, planning and enforcement: Providing the resources necessary for all aspects of management of the fishery.

- Benefit distribution: Using economic tools to distribute benefits from the fishery to address community and economic sustainability.

- Integrated policy: Planning fisheries, including setting explicit objectives that address all the dimensions of sustainability and the interactions among the factors of unsustainability.

- Precautionary approach: Application according to FAO guidance.

- Capacity building and public awareness raising: Development and application of programmes to better inform policymakers and the public at large about main fisheries issues.

- Market Incentives: Using market tools in situations where they are appropriate for addressing factors of unsustainability.

The table below lists main factors of unsustainability in the left hand column and possible paths to solutions in the right hand column. Paths to solutions are expected to vary between fishery management processes. These paths to solutions address the types of factors in the ways tabulated below.

| Main factors of unsustainability | Paths to solutions<br>(with indicative linkage to relevant factors) |
|---|---|
| 1. Inappropriate incentives<br>2. High demand for limited resources<br>3. Poverty and lack of alternatives<br>4. Complexity and lack of knowledge<br>5. Lack of governance<br>6. Interactions of the fishery sector with other sectors, and the environment | Rights (1)<br>Transparent, participatory, management (1,2,5)<br>Support – science, enforcement, planning (4,5)<br>Benefit distribution (1,3)<br>Integrated policy (1,3)<br>Precautionary approach (4,6)<br>Capacity building and public awareness building (5)<br>Market Incentives (1,2) |

**Recommendations on factors of unsustainability**

Recommendations are given below in reference to the six main factors of unsustainability as previously identified.

*Inappropriate incentives*

Inappropriate incentives lead to a short-term view and overcapitalization as exemplified by the race for fish. Lack of transparency and participation of fishers in the management system undermines confidence and willingness to support management measures. Participants in fisheries should be given incentives for long-term conservation and efficiency.

Measures that can give appropriate incentives include: (i) assigning secure rights to shares of fisheries, e.g. in terms of areas, effort units or catch; (ii) using market measures (e.g. certification) to discourage unsustainable fisheries; (iii) allowing all legitimate stakeholders (interested parties) to participate meaningfully in fisheries management including setting objectives, providing input to science, evaluating options and reviewing performance relative to objectives. Meaningful participation will vary geographically and by culture but it should always be transparent and provide full access to information.

*High demand for limited resources*

Fisheries policy must address the need to align the capacity of fisheries to the marine resources available. Appropriate incentives will assist in resolving this problem as indicated above. Governments must consider fully and explicitly the role that fisheries are to play in the macro-economics of their countries (*inter alia* through setting explicit objectives) and ensure that the role they envisage is sustainable in all the dimensions of sustainability. In particular, great care should be taken with policies that focus on increasing quantities produced, given the resource constraints of fisheries. Attention should also be given to the conflict between internal and external demand and food security.

*Poverty and lack of alternatives*

Use rights should be designed to satisfy societal views of fairness and equity. Benefits from more efficient fisheries management may be used to create alternative employment opportunities. The fishery cannot be expected to solve the problem of poverty and lack of employment. Inadequate management will only make them worse.

*Complexity and inadequate knowledge (social, economic, bio-ecological)*

Fisheries are complex systems with strong and poorly understood interdependencies between social, economic and bio-ecological factors. The knowledge needed to deal with them is largely insufficient. Fisheries authorities should:

- improve data collection (e.g. fisheries statistics) and fisheries monitoring including systems of indicators;
- support sustainable scientific programs for fisheries assessment, formulation of advice, evaluation of policies and management performance;
- promote the integration of fishers' and scientific knowledge; and
- build capacity for management.

*Ineffective systems of governance*

Consistent with a precautionary approach, participants in fisheries management systems should assess the uncertainties and adopt appropriate measures to address the inter-related risks in the economic, institutional, community and ecological dimensions of sustainability.

Institutional sustainability is a component of the overall concept of sustainability. Fishery management institutions should be appropriately funded, possibly through revenues generated by the fishery itself. Under appropriate conditions, delegation of selected management functions to local institutions can be promoted.

Participation of interested parties at all stages of the management process should be ensured. Fishery authorities should promote capacity building and increased public awareness of the need for conservation and management, including for policymakers and the general public.

Local, regional, national and international fisheries management bodies must be provided with adequate resources for monitoring, control and surveillance (including law enforcement) to fulfill their mandate and functions effectively.

The performance of new and existing management approaches and measures should be evaluated over time in order to assess their effectiveness in achieving the intended objectives and to promote institutional learning.

International financial and technical assistance institutions should ensure that their resources do not contribute towards unsustainable fisheries. This should occur consistently and be harmonized at the various levels of governance.

In areas where fishery management institutions do not exist, e.g. in the High Seas, they should be created by the governments concerned so that all the world's marine areas are managed by management institutions.

Where fisheries management institutions exist (or are created), these should be strengthened sufficiently to be able to play their necessary roles. This strengthening should include, as a minimum, receiving clear legal authority to manage and conserve fisheries resources; receiving both the mandate and the resources to ensure compliance with management and conservation policies and regulations; having effective dispute settlement mechanisms in their legal structure; regular performance evaluation of their policies in achieving their objectives.

Donors and international financial communities should actively promote and assist the participation of developing countries in regional fisheries management organizations so that their participation ensures the achievement of the objectives of those organizations.

Interactions of the fishery sector with other sectors, and the environment

Government departments responsible for fisheries must take a lead role in protecting the fishery, the resources, and their habitats, from external threats of pollution and contaminants,

habitat damage, etc. and in ensuring that the fisheries sector is recognized as a legitimate user in coastal areas.

**Recommendations on the process started with the Workshop**

The following recommendations were made regarding the process started with this Workshop:

- Case studies should be pursued, as indicated in the Workshop Report.

- The tabulations of consequences and potential effectiveness of factors of unsustainability by area, fishery, management activity, etc. that were begun at this Workshop, appear potentially the source of useful insights, or at least effective organization of knowledge. These tabulations should be completed, analyzed, and interpreted.

- The final outcome of this work should be widely communicated and integrated in other fora dealing with sustainability. This could be achieved in an interactive workshop involving policy makers, fishery managers, industry and other interested parties.

- In its future work, including case studies (1) the project should give substantial attention to situations and case histories in the developing world.

## 6. RELATIONSHIP BETWEEN FACTORS OF UNSUSTAINABILITY AND INTERNATIONAL FISHERIES INSTRUMENTS

**Presentation of Discussion Paper**

Under this agenda item a review was made of the way in which the main factors contributing to unsustainability and overexploitation in fisheries are addressed by international fisheries instruments. The topic was introduced by Mr Michael Lodge on the basis of Discussion Paper II. He noted that in recent years the international legal and policy framework for fisheries management has been substantially improved as a result of action taken both within FAO and the broader United Nations system, as well as at the regional level. These actions have resulted in a complex web of both "hard" and "soft" law provisions giving rise to a variety of rights, duties and obligations. While considerable progress has been made by States and within regional fishery bodies in the implementation of international fisheries instruments, there is a need for continuous review and assessment of the progress that has been made with a view to a more efficient application of the provisions of those instruments.

Michael Lodge provided a general overview of the status of the main international fisheries instruments and their relationship to the major factors identified in the FAO study. He noted that, although his review was a very broad overview, the type of methodology involved may be further refined and used as a basis for a more detailed assessment of the opportunities, constraints and priorities for implementation of existing instruments as well as the identification of possible gaps and constraints to implementation.

Michael Lodge commented that, as confirmed by the FAO study, marine resource development cannot be viewed independently of overall socio-economic development. The dimension added by the marine sector must therefore be viewed in the overall context of

national development priorities. Governments need to better integrate their policies on marine development in their overall development strategies so as to ensure an appropriate allocation of resources between the marine and other sectors. It is important, therefore, that any administrative structure or mechanism for ocean management should ensure adequate coordination at the national level. Such a structure should allow for the initiation and implementation of national ocean development objectives while at the same time facilitating the discharge of obligations relating to regional and global ocean management, especially those reflected in the Convention. Such coordination at the national level will also ensure more effective collaboration bilaterally and multilaterally with the various international and regional organizations and agencies that have been given a role to play in the system of global ocean governance. He stressed also that the problem with ocean governance generally today is not that there is no legal framework but rather how States should act in the discharge of their responsibilities under the Convention and related instruments and in the exercise of the rights and duties ascribed to them.

It was noted that one of the most significant and important trends in recent years had been the emphasis on the role of flag states as well as the role of regional fishery bodies in promoting sustainable management of fisheries, especially shared fish stocks and straddling and highly migratory fish stocks. Indeed, in the case of the latter categories, the regional fishery body is established by UN Fish Stocks Agreement as the primary mechanism through which States should fulfill their obligation to cooperate under the 1982 LOS Convention. The review therefore focused on the capacity of these bodies to carry out the mandates entrusted to them. Cursory analysis revealed that many of the existing regional fishery bodies are ineffective and have not successfully addressed key factors affecting sustainability including those relating to compliance, illegal, unregulated and unreported fishing, as well as effective decision-making. Further work needs to be done (which may be done effectively through FAO) to strengthen regional fishery bodies to ensure that these bodies (a) meet the standards established by the relevant international fishery instruments, and (b) possess the necessary mandates to enable them to address the factors affecting sustainability.

In conclusion, Michael Lodge stated that international fishery instruments developed since the early 1990s addressed directly or indirectly many of the factors of unsustainability in fisheries and revealed a high level of consensus at the international level on the factors to be addressed. He suggested that the key international fishery instruments would benefit from a more detailed examination and assessment against a more precisely-defined and internationally agreed list of factors contributing to unsustainability. He also suggested that the main problem is not primarily a lack of internationally-agreed measures to address problems of unsustainability, but a problem of failure to implement existing instruments.

Following this presentation, Ms Annick Van Houtte took some time to reflect on the development of the rules for ocean governance and to consider whether the legal framework for ocean governance needs to be improved in the light of the factors of unsustainability which have been identified. The prevailing factor in the law making process was the economic interests of states. In addition the fishing industry is (and has always been) a market-driven and increasingly dynamic internationalized sector. The 1982 UN Convention was a way to rationalize competing claims in a manner that would address: (i) the potential conflicts among States and between States; (ii) the competing uses of the ocean; and (iii) the impact of these activities on the marine environment. The Rio Conference in 1992 and Agenda 21 prompted a number of major developments in ocean governance but while the 1982 UN Convention was still being negotiated and until Rio, a number of other instruments,

regulatory and technical instruments were established through global and regional organizations. She noted that over the past years the international instruments, whether soft or hard law, have tried to address elements of social, economic bio-ecological and institutional dimensions of unsustainability, sometimes explicitly, sometimes indirectly. It may be asked whether international instruments should favor one dimension or element of a dimension more than another one and if so for which reasons. Clearly all these international instruments (whether soft law or hard law) were negotiated by countries under pressing need(s), and establish responsibilities primarily for countries and governments. It could be useful to analyze and relate the various instruments against the relationship between different factors of unsustainability identified. Likewise it would be helpful to examine the impacts of these instruments according to their impact on humans, on the environment (the resources), on technology and on institutions (governance).

**Discussions**

Following these presentations, issues relating to the functioning and structure of Regional Fisheries Organizations were discussed. It was also pointed out that in order to function effectively regional organizations need the appropriate technical skills, human resources, as well as financial resources, particularly for developing countries. The costs of implementing international instruments can be indeed prohibitive. International instruments run the risk of losing their legitimacy because of cost implications. Some participants felt that sub-regional organizations were in a better position than regional organizations to deal with certain aspects of management of small-scale fisheries, their priorities and particularities.

The specific problem of exclusively high seas fisheries was considered (other than straddling and highly migratory fish stocks). It was also asked whether the current international fisheries instruments adequately address the factors of unsustainability. The workshop noted that the objective of UN Fish Stocks Agreement (UNFSA) was to ensure the long-term conservation and sustainable use of straddling fish stocks and highly migratory fish stocks. In this context it was questioned whether the current international framework for fisheries management could constitute an appropriate tool for the effective management of high seas fisheries resources other than those covered under the UNFSA. It was noted that the lack of international regulation of such resources was a significant problem that had not been addressed in the UNFSA. The problem of securing adequate flag State enforcement was also highlighted. In the case of seamounts, it was further noted that multiple use conflicts would be likely to arise in the future with respect to exploration for deep-sea mineral resources, bio-prospecting and fisheries. These problems would need to be addressed through international management of the resources concerned.

Attention was drawn to the role of research for the purposes of implementing management and conservation measures whether at national, sub-regional or regional level. Some participants noted the possibility of scientific research being provided by independent bodies other than the management organizations.

It was further questioned whether there was a need for a factor of unsustainability such as profitability to be addressed in international instruments. Profitability *per se* was not felt to be a negative factor and in this respect it was pointed out that several instruments and, *inter alia,* the IPOA for the Management of Fishing Capacity addressed certain negative impacts (i.e. contributing to unsustainability) of profitability.

Some participants felt that it was worth reflecting on the development of rules for the conservation and management of resources combined with trade-related measures. A few regional fisheries management organizations have discussed and/or adopted some measures which limit the trade in fish and fisheries products from a country or countries to avoid that management and conservation measures are undermined or to curb illegal, unregulated and unreported fishing activities. Concern was also expressed on the possible impacts of the Multilateral Trade Agreements in Goods (e.g. the Agreement on Sanitary and Phytosanitary Measures and the Agreement on Technical Barriers to Trade) that are likely to have an impact on trade in fish and fishery products, in particular on export from developing countries. It was asked whether studies or other activities on this topic were taking place under the auspices of WTO and/or FAO.

## 7. RECOMMENDATIONS ON FACTORS OF UNSUSTAINABILITY AND INTERNATIONAL FISHERIES INSTRUMENTS

The number of international instruments dealing with aspects of ocean governance is impressive as are the problems related to the implementation of these instruments. The adoption of harmonized approaches towards the implementation of international fisheries instruments, whether at national, sub-regional or regional level is vital. Countries as well as regional fisheries organizations could well benefit from guidance and advice in implementing international fisheries instruments.

*Recommendations relating to the relationship between factors of unsustainability and international fisheries instruments*

- International fishery instruments address directly or indirectly many of the factors of unsustainability in fisheries and reveal a high level of consensus at the international level on the factors to be addressed. A major problem is one of failure to implement existing instruments. More guidance and capacity-building activities should be directed at the implementation of international instruments at national, subregional and regional level.

- The workshop concluded that the key international fishery instruments would benefit from a more detailed analysis and assessment against a more precisely-defined list of factors of unsustainability, but that such a study should also identify specific weaknesses in the current international framework, especially relating to the management of high seas resources (other than straddling and highly migratory stocks) and propose solutions. Among the weaknesses in the current regime identified by the workshop were the problems of effective management of exclusively high seas resources, effective enforcement by the flag State and the effective implementation of internationally-agreed market-related measures.

*Recommendations relating to the role of subregional and regional fisheries bodies*

- The workshop noted that the focus of many of the international fishery instruments is on action at the regional level, primarily through regional fishery bodies. In the case of straddling and highly migratory fish stocks, the UNFSA establishes the regional fishery management organization as the primary mechanism through which States should fulfill their obligation to cooperate in conservation and management under the 1982 Convention on the Law of the Sea.

- The workshop further noted that some of the existing regional fishery management organizations are ineffective, while others have not yet successfully addressed key factors of unsustainability including those relating to compliance, illegal, unregulated and unreported fishing, effective decision-making, the provision of independent scientific advice in accordance with the standards established in international fishery instruments and the implementation of internationally-agreed market-related measures. Among the specific constraints to the effective operation of some regional fishery bodies are lack of resources and lack of effective participation by members, particularly developing countries. Additional efforts should be directed at addressing these constraints.

- In order to promote effective implementation of international fishery instruments at subregional and regional level, the workshop considered it was necessary to strengthen regional fishery bodies to ensure that they:
  a) meet the standards established by the relevant international fishery instruments;
  b) possess the necessary mandates to enable them to address the factors of unsustainability; and
  c) are equipped to carry out the functions ascribed to them, including by having an adequate resource base and by providing mechanisms for effective participation in their work by all members.

- The workshop recommended that further studies be carried out to analyse, against uniform and harmonized standards, the characteristics and capacities of regional fishery bodies and make recommendations for the strengthening of such bodies.

## APPENDIX A

AGENDA OF THE WORKSHOP

| | |
|---|---|
| Day 1 am: Session 1<br>(9.00-12.30) | Opening<br>Presentation of the main discussion document by S. Cunningham and J.-J. Maguire. Discussion |
| Day 1 pm: Session 2<br>(13.30-17.00) | Separate into 2 working groups<br><br>**Task:** Identify key factors of unsustainability and overexploitation in marine fisheries.<br><br>**Steps**: - Briefly discuss unsustainability<br>- List factors<br>- Select key factors<br>- identify key interactions between factors<br><br>**Approach:** General discussion, even if reference is made in the course of discussion to factors especially affecting particular fisheries or countries (e.g. developed or developing countries; small scale or coastal fisheries; highly migratory or small pelagic stocks; tropical or temperate fisheries; etc.). |
| Day 2 am: Session 3 | Continued |
| Day 2 pm: Session 4 | Plenary<br>Presentation of results of each group and discussion.<br>Agree on what the problem is and how to address it. |
| Day 3 am: Session 5 | Separate into 2 working groups<br><br>**Task**: Relate key factors of unsustainability to fisheries management (methods and approaches).<br><br>**Steps**:<br><br>- Identify difficulties in progressing towards more sustainable outcomes (in relation to key factors identified by the group);<br><br>- Suggest avenues to better accounts for these factors in the promotion of responsible fisheries management.<br><br>**Approach**: Innovative, with focus on management methods and approaches. |
| Day 3 pm: Session 6 | Continued |
| Day 4 am: Session 7 | Plenary<br>Presentation of results by each group and discussion |
| Day 4 pm: Session 8 | FREE |
| Day 5 am: Session 9 | Presentation of document by M. Lodge.<br>Discussion of findings in relation to major international fisheries instruments and possible avenues for improved fisheries management. |
| Day 5 pm: Session 10 | Adoption of summary conclusions and recommendations |

## APPENDIX B

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## APPENDIX C

## OPENING STATEMENT BY DR R. B. SINGH
## ASSISTANT DIRECTOR-GENERAL
## FAO REGIONAL REPRESENTATIVE FOR ASIA AND THE PACIFIC

Distinguished participants,
Ladies and Gentlemen

In the name of the Director-General of FAO, Mr Jacques DIOUF, it is my pleasure to welcome you to this international workshop and to our Regional Office for Asia and the Pacific here in Bangkok. I am pleased to note that 30 experts from 17 countries, representing different continents of the world are participating. I am doubly pleased that you represent different disciplines such as biology, environment, social sciences, economics, policy and political geography, which are interactively related with the theme of this Workshop. Given the diverse and rich presence of the experts, I am assured of a fruitful outcome from this meeting. Since each one of you is participating in your individual capacity as an expert, I am sure your contributions will be totally free from any restrictions.

Over the course of this week, the workshop will address very important issues related to factors of unsustainability and overexploitation in fisheries. The workshop is part of a broader project, undertaken by FAO with the financial support of Japan, and aimed at achieving a more holistic approach to sustainable fisheries. I would like to take this opportunity to thank the Government of Japan for its support.

The concept of sustainability has been fundamental to fisheries management for many decades - at least in terms of conserving fisheries resources and of balancing present and future yields. Within the last twenty years or so, it has also featured as the critical theme in major national and international policy declarations. The concerns of sustainable fisheries and coastal development prominently figure in Agenda 21 (of the Earth Summit, 1982) and have been internalized in various national and international policy framework and programmes. Fundamental to the realization of the concept of sustainability is the change in attitude and thinking process of all concerned. As long as individuals and societies realize that "we have borrowed the natural resources from our children and not inherited them from our parents", necessary commitment toward sustainable development will emerge naturally.

It is indeed distressing that an unacceptable number of the world's fisheries are in an unsustainable state or under threat, as shown by FAO and as illustrated for example by the fact that the number of declining fisheries has regularly increased over the last 50 years. The precarious state of world fisheries is of major concern because of its widespread negative consequences for food security, the livelihood of fisheries-dependent communities and for marine ecosystem integrity and productivity. Marine capture fisheries seem to have reached their ceiling of about 100 million tonnes. Should this be acceptable to all those concerned with fisheries?

It is good that FAO has now been duly reflecting the role of fisheries in food security and poverty alleviation. Asia's consumption of fish comprised two-thirds of the world's total

production. Close to 50 percent of protein is derived from fish consumption in Bangladesh, Democratic People's Republic of Korea, Indonesia, Japan, Cambodia and the Republic of Korea. Besides, their richness in calcium, vitamin A, Omega-3-fatty acids and iodine, greatly add to the nutrition adequacy.

Statistics on fisheries has often been inadequate and unrealistic. Recent controversies on production figures and their impact on global fisheries production and trade highlight the weakness. Since information (gathered through data collection and surveys) underpins policy formulation and planning, the urgency for strengthening national capacities in fisheries statistics can hardly be overemphasized. FAO must redeploy or strengthen its resources to bridge this gap.

This deplorable state of affairs exists despite the fact that nobody involved in any fishery management process is seeking to deplete valuable fish stocks. From fishers trying to earn a living, to the Minister of Fisheries making decisions on management, and the scientists providing advice, all interested parties want to achieve long-term sustainable fisheries that provide economic opportunities, food, and stable communities. Unfortunately, and in spite of progress observed in some fisheries, evidence still points to the inability of fisheries institutions and management systems to maintain stocks in an acceptable long-term condition of exploitation.

Growing awareness and concern about the state of fisheries resources and the need for management has led to the adoption of the Code of Conduct for Responsible Fisheries in 1995 as well as a number of complementary international fisheries instruments such as the four International Plans of Action adopted by COFI since 1999 and the 2001 Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem.

Many national and international institutions - including NGOs - are also taking steps to address these issues. For example, ASEAN countries met just three months ago here in Bangkok to discuss fisheries management issues and its Ministers Session adopted an important resolution on Sustainable Fisheries for Food Security. Other international fora have also addressed related issues such as: subsidies, trade and eco-labeling. These initiatives are definite signs of increasing commitment to sustainable fisheries and of a search for improved management approaches and methods.

As a further contribution to this search, the present workshop aims at providing some perspective on management issues by going back to basics. It will provide an opportunity to discuss the very roots of unsustainability and overexploitation in a global and multi-disciplinary manner. Identifying factors of unsustainability and overexploitation in fisheries will not be easy because the causes most probably result from a complex web of interactions leading to the undesired side effect of stock depletion. The task of this workshop is therefore quite challenging, but I am sure that its outcome will prove most useful in identifying and developing new avenues for sustainable fisheries.

As you will be disaggregating the various causes of unsustainable fisheries and seeking the malady-remedy combination, I wish to emphasize two people-centered points for your consideration. Firstly, a main root cause of unsustainability is poverty. The habitat and life style of coastal people and their livelihood status and pattern has a direct bearing on fisheries unsustainability and overexploitation. The human and socio-economic aspect of the phenomenon must be critically examined. Secondly, greed is the other main cause of unsustainable exploitation. To paraphrase Mahatma Gandhi, nature has provided enough to meet

the needs and demands of the entire humankind, but not to meet the greed of the greedy. A meeting like this can influence the thinking process at country and international levels and help faithful implementation of the Code of Conduct for Responsible Fisheries.

With these few words, it is now my pleasure to declare this Workshop open and to wish you every success in your deliberations.

I thank you for your attention.

## PART II: DISCUSSION PAPERS

**Discussion Paper 1:** **FACTORS OF UNSUSTAINABILITY IN FISHERIES**
by
**Stephen Cunningham and Jean-Jacques Maguire**

**Discussion Paper 2:** **REVIEW OF FACTORS OF UNSUSTAINABILITY IN FISHERIES: RELATIONSHIP TO INTERNATIONAL FISHERIES INSTRUMENTS**
by
**Michael Lodge**

DISCUSSION PAPER 1

# FACTORS OF UNSUSTAINABILITY IN FISHERIES

A discussion paper prepared for FAO by

Stephen Cunningham and Jean-Jacques Maguire

## 1. Introduction

There is widespread concern about the precarious condition of world fisheries. Garcia and Staples (2000, p. 390) point out that "most fisheries are presently in a non-sustainable state as illustrated by the progressive decline of the state of world marine resources since the 1950s (Grainger and Garcia 1996). The number of declining fisheries has regularly increased since the 1950s, pointing to an inability of the fishery institution and management systems [...] to develop a resource and maintain it in an acceptable long-term (dynamic) equilibrium." Ludwig *et al.* (1993) further observe that "there is remarkable consistency in the history of resource exploitation: resources are inevitably overexploited, often to the point of collapse or extinction. (p. 547)". Considering the number of resources on which little or no information is available and the uncertainties affecting fisheries statistics, the situation may even be worst than it appears. The generalised overexploitation of world fish resources has widespread negative consequences, for instance on food security, on the socio-economic well-being of communities dependent on fishing and for the ecosystem.

This trend towards unsustainability has occurred despite the fact that "the concept of 'sustainability' of the natural resource base has been implicitly or explicitly present in the fundamentals of fisheries management at least since the 1950s [...]and is explicitly dealt with in seminal contributions of biologists (e.g. Hjort, Schaefer, Beverton, Holt, Gulland, Ricker and Cushing) and economists (Scott, Gordon)" (Garcia and Staples (2000) p. 390).

Faced with this situation, an FAO project has been established to explore the factors giving rise to unsustainability and develop appropriate remedies. The specific objectives set out in the project document are to establish:

1. What are the key factors contributing to fisheries overexploitation and unsustainability?
2. How do these factors interact?
3. Which are the priority issues in addressing fisheries overexploitation and unsustainability?
4. What are the best practical approaches to address long-concern (long-term concern?) of fisheries overexploitation and unsustainability?

This paper is principally concerned with the first question, and to a lesser extent the second one. We begin by discussing in section 2 the nature of unsustainability. In section 3, we point out that unsustainability may be a problem even in the absence of fishing. Two broad threats to the sustainability of unexploited fish resources may be identified: natural variability and external threats. We then consider what happens once exploitation begins, identifying factors that might lead to unsustainability under a number of stylised management systems. Section 4 presents the management scenarios and section 5 discusses the factors. In section 6 we discuss

what appear to be the main threats to each management system. Section 7 concludes the document.

## 2. The nature of unsustainability

Before discussing unsustainability, it is useful to consider the concept of sustainability. FAO defines sustainable development as "The management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Such sustainable development conserves (land,) water, plants and (animal) genetic resources, is environmentally non-degrading, technologically appropriate, economically viable and socially acceptable" (Garcia 2000).

Charles (2001, especially chapter 10) sees the perspective on sustainability as having changed from that of "sustainable yield" (where the focus was on physical output) to one of "sustainability" with "multiple objectives" (focussing on both the ecosystem and the human system, and a balance of resource conservation and human concerns). The FAO guidelines on sustainable indicators for fisheries (FAO, 1999) recognize fully the need to ensure both human and ecosystem well-being In a sustainable development context, Charles (op. cit.) stresses that "there is wide recognition of the need to view sustainability broadly, in an 'integrated' manner that includes ecological, economic, social and institutional aspects of the full system" (p. 186). His definitions of the four components of sustainability are given below:

- *"Ecological sustainability incorporates (a) the long-standing concern for ensuring that harvests are sustainable, in the sense of avoiding depletion of the fish stocks, (b) the broader concern of maintaining the resource base and related species at levels that do not foreclose future options, and (c) the fundamental task of maintaining or enhancing the resilience and overall health of the ecosystem.*
- *Socio-economic sustainability focuses on the 'macro' level, i.e. on maintaining or enhancing overall long-term socio-economic welfare. This socio-economic welfare is based on a blend of relevant economic and social indicators, focussing essentially on the generation of sustainable net benefits (including resource rents), a reasonable distribution of those benefits amongst the fishery participants, and maintenance of the system's overall viability within local and global economies.*
- *Community sustainability emphasizes the 'micro' level, i.e. focusing on the desirability of sustaining communities as valuable human systems in their own right, and more than simple collections of individuals. Hence, emphasis is on maintaining or enhancing the 'group' welfare of human communities in the fishery system by maintaining or enhancing, in each community, its economic and sociocultural well-being, its overall cohesiveness, and the long-term health of the relevant human systems. Why worry about human communities within a sustainable fishery policy? The idea is that sustainable fisheries go hand in hand with sustainable communities. Not only are the communities important in their own right, but since sustainable communities are by definition self-supporting, it is in the interest not only of the communities themselves, but of citizens/taxpayers everywhere."*
- *Institutional sustainability involves maintaining suitable financial, administrative and organisational capability over the long-term, as a prerequisite for these three*

> *components of sustainability. Institutional sustainability refers in particular to the sets of management rules by which the fishery is governed, and the organisations that implement those rules: the bodies and agencies that manage the fishery, whether at the governmental, fisher or community level, and whether formally (e.g. the legal system and governmental agencies) or informally (e.g. fisher associations and non-governmental organisations). A key requirement in the pursuit of institutional sustainability is likely to be the manageability and enforceability of resource-use regulations*" (p. 188-189).

He views ecological, socio-economic and community sustainability as the three points of a triangle, with institutional stability as the cement holding the other three together. He suggests (Charles 2001, p190, emphasis added) that "Sustainable development policy must serve to maintain reasonable levels of each (component)". But who is to decide what is reasonable? The concept of sustainability does not offer simple policy prescriptions, but requires policy choices to be made, taking account of social preferences and societal values.

From a biological perspective, sustainability does not correspond to a unique yield or fishing effort value such as Maximum Sustainable Yield (MSY) and the corresponding effort. Biological sustainability can be achieved at any of the fishing effort values on the yield versus fishing effort curve except at the fishing effort corresponding to stock collapse. A similar curve can be constructed for the economic yield, but models do not exist to formally define the value of the other components of sustainability under various configurations of the fishery system. Nevertheless, it is reasonable to expect curves with similar shapes. From a fishery system perspective, it is not possible to define universally acceptable quantified definitions of the four components of sustainability. Our approach is to indicate in what direction a given factor may influence the different components of sustainability under different management regimes.

In addition to the four components of sustainability defined above, we use *biological sustainability*, when discussing single species resources.

## 3. Unsustainability without exploitation

Unsustainability is often associated with overexploitation. However, although exploitation is doubtless an important factor, the size of fish resources fluctuates from natural causes and may be threatened with biological unsustainability even if the resource is not exploited. In the absence of exploitation a fish resource faces two major threats to its sustainability:

- Natural variations: the unsustainability of nature;
- External threats: the impact of human activities not related to exploitation of the fish resource.

### *3.1. Natural variations*

Archaeological records (Baumgartner, Soutar and Ferreira-Bartrina 1992) show large fluctuations in the deposition of sardine and anchovy scales off the coast of California over a period of two millennia. The fluctuations prior to significant exploitation by human, which really began in the 20th century, are interpreted as indications of changes in abundance due to natural cycles possibly mediated through climatic changes. Kawasaki (1983) by suggesting that some species of small pelagic fishes in distant locales were fluctuating in synchrony is at

the origin of a large number of studies between climate and fish stock fluctuations. In one of the most recent studies on this subject, Klyashtorin (2001), after identifying 50-60 years cycles in both fish abundance and a climate index, suggests that some species thrive during periods of increasing temperature while others do so during periods of decreases. He goes as far as developing a model using climate indices to predict commercial fish catches from 5 to 15 years in advance.

Given that the hydro-climatic conditions change over time, and that each species has specific requirements in terms of temperature, salinity, oxygen content etc., it is not surprising that the abundance, and even the presence of species varies over time for reasons other than fishing. The case of Atlantic cod in offshore Greenland waters is illustrative in this regard. Buch, Horsted and Hovgård (1994) describe how, in offshore Greenland waters, there were periods with cod and periods without cod, depending on water temperature. Baltic cod provides another example of environmental influence on the fate of a fish stock. Adult and juvenile cod are adapted to the low salinity of the Baltic sea, but reproductive success is linked, among other factors, to salinity and oxygen content with periods of good recruitment corresponding with the intrusion of saline and oxygenated North Sea waters (Aro 2000).

Whether or not time confirms the validity of the specific predictions made by Klyashtorin (2001), there is no doubt that climate does cause groundfish and pelagic fish stock abundance to vary. But is exploitation by human more important than natural changes? DeYoung *et al.* (1999) provide a sensible summary for Canadian groundfishes "... without the effect of fishing, some of the stocks may not have collapsed when they did or at all, and similarly, without unfavourable environmental conditions, other stocks may not have collapsed when they did or at all."

The ecological component of the fishery system is therefore dynamic and ecological sustainability does not mean that resources will not fluctuate and that the species mix will not change over time as climate does.

### *3.2. External threats*

These relate to the activities of humans which are not concerned with the direct exploitation of the fish resource itself. Two kinds of threat can be identified: deliberate and accidental.

In the first case, a deliberate decision might be made that the unsustainability of the fish resource may be a price that has to be paid in order to achieve some other benefit. For instance, it may be recognized that certain fish resources depend on mangroves, but it may still be considered desirable to clear the mangroves. In this context, unsustainability is part of a trade-off and comes within the scope of social benefit-cost analysis, provided that all benefits and costs are properly identified. Such decisions may not be openly acknowledged, but they are nevertheless possible.

The second kind of situation is probably more frequent. No explicit consideration is given to the impact of other activities on the sustainability of the fish resource. Instead, the resource may simply bear some of the cost of the other activities. The fish resource may face a number of external threats, even if it is not exploited. Classic examples are coastal area development which may threaten important habitat, and land-based pollution which may originate far inland. Where the resource is not exploited, it will have no obvious value and policymakers in other sectors will probably pay little regard to it.

### *3.3. Scope for intervention*

History tells us that decreased exploitation may lead to stock rebuilding as indicated by:

- demersal stocks in the North Sea increased substantially during both world wars;
- rapid rebuilding of hake occurred after Namibia became independent in 1990;
- strong management action by Norway and Russia in 1989, combined with strong recruitment and favourable growth conditions resulted in rapid increases in the spawning biomass of Northeast Arctic cod.

However, although substantial decreases in fishing mortality for groundfishes on Georges Bank off New England helped rebuild depleted haddock and yellowtail stocks, cod remains depressed in the same area. Decreased fishing mortality may therefore be a pre-condition for stock rebuilding, but it does not guarantee that stocks will rebuild. Several other cod stocks to the north in Canadian waters also remain below average even if fishing mortality has been drastically reduced.

## 4. The management scenarios

Although an unexploited fish resource may face some threats to its sustainability, the problem of unsustainability is likely to increase in importance once exploitation begins. Exploitation will reduce the size of the standing stock thereby tending to increase its vulnerability to natural variability. In general, exploitation of a fishery begins at a relatively low level but tends to increase over time. In many fisheries, exploitation has gradually become overexploitation, increasing the risk of unsustainability, even if the fishery may continue in a sustainable manner for a number of years with a low fish stock producing relatively low outputs. Hence although overexploitation and unsustainability are not synonymous, there is a strong relationship between them. An understanding of the factors that may lead to unsustainability requires consideration of the factors that lead to overexploitation.

In the following section we discuss the factors that might lead to unsustainability in the case of fisheries being exploited under a variety of management arrangements. We begin here by outlining a set of stylised management systems.

### *4.1. No management*

In the absence of management, access to the fishery is free and open. This scenario is of interest for a number of reasons:

- First and foremost, it provides a baseline against which to judge the impact of different fishery management systems and instruments on both overexploitation and the risk of unsustainability (in its different dimensions)
- Second, no management seems a reasonable description of most fisheries in their early stages of exploitation. Although such fisheries may not be characterized as unsustainable, the risk is of establishing economic incentives and dynamics which will lead to unsustainability.
- Third, a situation of no management seems to describe many high-seas fisheries.

- Fourth, no management describes the "effective" situation in a number of EEZ fisheries, where in theory management should be in place.

### *4.2. With management*

We examine the following six sets of possible management arrangements that seem to describe reasonably well the current management situation in many world fisheries and the process through which "modern" fishery management passed in order to try to improve fishery management:

- Technical conservation measures
- Input controls
- Overall output controls (TACs)
- Use rights
- Market measures
- Co-management

The first three scenarios are traditional management arrangements, in the order that they have been implemented in many jurisdictions. The last three are of a different nature and can be applied under a number of different arrangements.

#### *4.2.1. Technical conservation measures*

Fishery management regimes often focus on fish stock conservation as a key objective. When fisheries management begins, a typical first step is to implement some technical conservation measures, the general aim of which is to protect or rebuild the fish stock by reducing fishing mortality, either overall or on particular age groups, especially juveniles. Typical measures include mesh size restrictions in trawl fisheries, limits on engine power, fish size limits, closed seasons, closed areas and so on.

#### *4.2.2. Input controls*

As it has become clearer that a primary factor leading to non-sustainability is free and open access to the resource, an increasing number of Governments have sought to restrict entry into their fisheries. The most commonly-used mechanism to implement limited entry has been fishing vessel licences, although rights also exist based on gear usage, e.g. the number of pots in a lobster fishery. The input control scenario is therefore mostly a limited-entry one, although it would be possible to control other input factors such as technology, vessel sizes etc.

#### *4.2.3. Overall output controls*

The basic idea underlying overall output control is straightforward: the total catch that the fishery can sustain is calculated, the Total Allowable Catch (TAC) is set, and once it is caught, fishing is stopped for the remainder of that season. Under this scenario, there is no specification of what proportion of the allowable catch may be taken by each participant.

#### *4.2.4. Use rights*

Rights to fishing entitlements can be assigned in several different currencies. The most commonly proposed system is in terms of catch (Individual Quotas - IQs). IQs may be assigned to individual persons, vessels, communities, and son and may be transferable or not. However, it is also possible to assign use rights in terms of effort quotas (e.g. the fishery

management system on the Faroe Islands), or in terms of area as has frequently been done in "traditional" management systems. It has even been suggested that rights could be assigned in terms of recruits (Gavaris 1996) in order to provide incentives to leave fish in the water until they have spawned at least once and reached a more profitable size. Licences are a kind of use right but they generally provide different economic incentives to rights such as IQs or area rights and are dealt with under input controls above.

#### *4.2.5. Market - based measures*

Rather than trying to control either inputs or outputs, management authorities could intervene in the market. The most-widely discussed approach is to introduce resource rentals requiring fishers to pay for the use of the resource. Such an approach is used in the management of other natural resources (for instance, oil) and with the development of "green" taxes it might become more common in fishing. So far, relatively little thought has been given to how resource rentals might be introduced into fishing. They may best be used in collaboration with other management measures (most probably IQs or licences). Thought should be given to how they might be introduced since there is no reason why they have to be in the traditional form and more novel approaches could prove more acceptable. One possibility might be to require use-rights holders to capitalise a local fund to support wider coastal community-based initiatives. Management on the market side might also be introduced in other ways. For instance, fish traders might be licensed. Alternatively, fish prices could be taxed (perhaps via a monopsony[i] -where the fishery is mainly for export, this might be a feasible alternative and it has been used by a few countries with some success). In both cases, it might be expected that reduced profits along the fish market chain will be pushed down towards the fishers, reducing economic incentives towards non-sustainability.

#### *4.2.6. Co-management*

Insufficient involvement of stakeholders in decisions concerning the management system has been linked to unsustainability. The term “co-management” is used to cover a wide range of possible institutional arrangements that might be used in fishery management. The key element is the sharing of management responsibilities between the State and communities or more conventional fisher organizations. It is often felt (Hollup 2000 pp. 407-409 for a recent brief review) that a primary advantage of co-management is that with increased user participation, the legitimacy of regulations will be increased and as a result so will be compliance. Implementation costs of management will therefore be reduced.

Co-management is not in itself a management system. Rather it establishes an institutional framework within which fishery management can occur. Choices will still have to be made concerning precise management arrangements, and the possibilities are likely to be similar to those discussed above in sections 4.2.1 to 4.2.5.

## 5. Factors of unsustainability

In addition to the threats to sustainability discussed in section 3 above which exist even in the absence of exploitation, an exploited fishery faces threats due to the nature of the exploitation itself. Three broad threats to the sustainability of an exploited fishery can therefore be identified:

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[1] A monopsony occurs when there is a single buyer and several suppliers (sellers).

- First, natural variability may be such that the resource and/or the activity based upon it is unsustainable regardless of the management regime
- Second, activities within the fishery may tend towards unsustainability (overexploitation)
- Third, activities outside the fishery may threaten the sustainability of the fishery (e.g. habitat loss, pollution, activity in other fisheries (by-catch and discards) etc).

Although the factors in the first and third group may be quite similar in the case of an unexploited and an exploited fishery, their impact may be different because where there is no exploitation the impact will be on the fish resource, whereas where there is exploitation the impact will be on the fishery (the resource being only a part of the fishery system albeit an important part).

Each of these broad threats may be sufficient to render a fishery unsustainable. Where they combine, the situation will be particularly serious. This seems to be the case in a number of developing country tropical fisheries where high natural variability combines with overexploitation and external threats associated with urban and industrial development.

There are a great many factors that may lead towards unsustainability under different management systems. As pointed out by reviewers of an early draft of this paper, it is difficult to be comprehensive in both breadth and depth without the discussion becoming unacceptably long. As a compromise, we propose to adopt a two-pronged approach, using a matrix format (Appendix 1) in an attempt to be comprehensive whilst discussing in more depth in this section what appear to be some of the key issues.

In the matrix, we identify as many factors as possible that impinge upon sustainability and consider how different kinds of management affect the situation. What emerges is that fishery management is not a simple process of identifying and correcting a set of problems. Instead, as management progresses some problems (factors of unsustainability) are resolved but others arise; and the nature of the factors may change in the sense that what leads to unsustainability under one set of management arrangements may not do so under another. Moreover, as one dimension of unsustainability becomes less of a concern, other dimensions come to the fore.

In the following sections, we discuss some of the most important factors of unsustainability and their effect under the various management arrangements (no management, technical conservation measures, input controls, overall output controls, use rights and market measures). Co-management is discussed as a separate category since it is qualitatively different to the other systems. In fact, each system may be developed on a co-management basis.

### *5.1. Profitability*

Profitability is a key issue in non-sustainability. The fishery must be (or must be expected to be) sufficiently profitable (at least over some time period) to encourage the investment leading to high (excessive) fishing effort. Exploitation will not develop in fisheries that are not profitable (although it may continue for reasons discussed below in exploited fisheries that become unprofitable) and hence (natural variation apart) such fish resources should not be unsustainable from a biological perspective, except perhaps for very low productivity species that might become depleted even as a by-catch. Individual fishers decide when, where and how much to fish on the basis of the expected profitability of fishing compared with other economic activities that they might undertake. Other things being equal, increased

profitability in fishing will lead to an increased demand to participate in the fishery, both by those within the fishery and those currently outside.

Under the no-management scenario, increased profitability will attract new entrants to the fishery and may also lead existing participants to intensify their activities. The result will be overcapacity (i.e. a step on the road towards socio-economic unsustainability) and, if profitability is sufficiently great, overfishing (i.e. a movement towards ecological unsustainability). Under this scenario, if profitability is maintained it is easy to imagine ecological, socio-economic and community unsustainability all occurring in due time, as happened for instance in the case of whaling. Institutional unsustainability is not relevant under this scenario.

Technical conservation measures do not control new entrants or limit investments by existing participants. Therefore, this arrangement will lead to the same unsustainability problems with respect to profitability as the no management scenario, with the possible addition of institutional unsustainability when the other three components have become unsustainable.

Input controls (limited-entry) could solve the problem of new entrants being attracted by the profitability of the fishery if it were implemented early enough in the development of the fishery, but that has rarely been the case. Instead, limited-entry has generally been implemented only once excess fishing capacity has built up. Limited-entry, by itself and in its simplest implementation, does not solve the problem of increased investment by existing participants. Although it may take longer than under the previous scenarios, increased profitability under a limited entry system is also likely to push the fishery towards unsustainability in the four components.

In theory, output control could resolve the problem of ecological unsustainability, but it does nothing to prevent socio-economic unsustainability. Once socio-economic unsustainability is reached, it is unlikely to be possible to avoid community unsustainability. Output control systems are also prone to institutional unsustainability, mostly because of uncertainties discussed below under that heading (section 5.3).

Under a rights-based management system, the effects of profitability become ambiguous. Rights assigned in terms of catch may give rise to "high-grading" where only the most valuable specimens of the allocated species are kept while the others are discarded, usually dead. But assigning rights may also increase the incentive to protect the source of income. The effects on socio-economic and community sustainability are equally ambiguous, depending on the specific parameters of individual systems.

Increased profitability comes from one of two sources: either because revenue has increased relative to costs, or because costs have declined relative to revenues, or some combination of the two. Factors that increase revenue and/or decrease cost are thus also linked to unsustainability and some are discussed below as sub-factors of profitability.

### *5.1.1. Increased demand for fish*

Revenue depends on the quantity landed and the price achieved. Quantity and price are related to one another through the demand curve. Over time, the demand curve for many fish species is tending to shift upwards for a variety of reasons: rising real incomes, rising populations, increased awareness of the health benefits of fish and so on. As a result, a given quantity of fish can be sold at increasing prices and hence real revenues increase (*ceteris paribus*) and so do profits in the short-term.

### *5.1.2. International trade aspects*

Trading opportunities may also be an important factor in increasing revenues. The traditional gains that are expected from trade need to be carefully considered in the fisheries context because of the rather unusual sectoral management arrangements that may exist. Although trade has increased, tariff and especially non-tariff barriers to trade still exist. Reducing barriers, or otherwise increasing trade opportunities, can be expected to increase profits for producers in exporting States leading to increased exploitation rates. If the fishery is thereby pushed towards non-sustainability, fish supply may be decreased in the longer term. The local population is likely to suffer doubly: first, because of the decreased general availability of fish, and secondly because an increasing proportion of what is available is likely to be exported. Ironically, the interests of the local population (in terms of food security and sustainability) may be best served where trade barriers have been erected by trading partners.

Since an important proportion of world trade involves exports from poor developing countries (which generally have no or limited fisheries management) to rich developed countries, its impact has almost certainly been towards non-sustainability. It must be emphasized that it is the lack of effective fishery management which is the main problem, but in a second best situation trade policy may also be called into question. Moreover, since the general trend has been for the exchange rates of the rich developed countries to appreciate relative to those of the developing countries, fishers in developing countries are faced with an increasing incentive to export their fish products. In itself, this is an opportunity for the developing countries but in order to realise it they have to start with a rational fishery management system. If they are unable or unwilling to put such a system in place, the opportunity becomes a threat to sustainability.

### *5.1.3. Changes in fish landings*

Changes in fish landings also affect revenues. In many fisheries, prices are set on the global market so that fishers are forced to take the prices on offer. In this case, revenue varies in the same direction as landings: an increase in quantity (because of increases in recruitment or as a result of good management) will increase revenue and vice-versa.

However, if fish prices depend on the quantity landed, then decreased landings could increase revenues, provided that price increases sufficiently to compensate for the decreased quantity. As a result, decreasing supply could lead to increased profitability. Such a fishery would face serious threats to sustainability, at least over a certain range of outputs. At low outputs, price effects may no longer suffice to maintain profitability; the situation would depend on the species and the nature of markets. Nonetheless, Clark (1973) showed that extinction might be the profit-maximising policy under some circumstances. This condition is generally a very severe test, although it may be more easily met in mixed fisheries where effectively the costs of extinguishing one species are subsidised by profits from exploiting another: the classic example being the way that exploitation in the Antarctic of the larger whales (blue and humpback) continued almost to extinction because whalers were able to target smaller sei and minke whales.

### *5.1.4. Decreased input costs*

If real fishing costs decline then profitability will increase leading again to higher exploitation. One factor may be variations in input prices, especially fuel prices, but also improved technology would be expected to decrease the cost of fishing. However, improved technology does not only play a role in terms of profitability. Therefore, it is discussed as a stand-alone factor, not as a sub-factor of profitability.

### *5.1.5. Resource rent*

The issue of resource rent in current fishery management processes is closely linked to that of profitability. If profitability as perceived by fishers increases, so will their demand to participate in the fishery. The fish stock is, however, a naturally-limited resource. In a fisheries context, increased demands to participate make the fish stock more valuable. If the stock belonged to an owner who charged rents to users then the rents would rise. But in the absence of management there is no one charging a rent for the use of the resource, and as a result this rent is perceived simply as part of profit by the users of the resource. As a result, they keep on entering the fishery until the resource rent has been driven down to zero.

The inability or unwillingness to collect resource rents (or establish institutional arrangements where they are capitalized) means that the fishery is driven to an exploitation rate that is much higher than is optimal from a purely economic point of view. Of course, higher exploitation rates may offer advantages that interest both users and policymakers, but they also push the fishery closer to the region of non-sustainability.

## *5.2. Access conditions*

Access conditions are another crucial factor in non-sustainability. Profitability determines the desire to exploit the resource, the institutional arrangements determining access conditions establish the terms under which exploitation may occur. Under no management and technical conservation measures, conditions of free and open access to fish resources exist. If the profitability conditions are met, such access arrangements allow overcapacity and overfishing to emerge.

Input controls deal with only one dimension of capacity: new entry. But, as discussed above, it leaves open the possibility for those who are already in the fishery to increase their effort within the capacity constraint imposed by the licence. The extent to which they can do this depends on the input substitution possibilities within the production function. In addition, if it is not made clear that the number of licences is fixed in relation to resource availability, the Government is likely to come under intense political pressure to allocate too many licences to begin with and to continue allocating licences over time. This is especially the case in the most common situation where licences are given away free on a discretionary basis. A different problem may arise in cases where licences have taken on a substantial value, because a Government may find it tempting to sell more licences at the going rate as a way of raising revenue. Clearly if the Government finds it difficult to control the number of licences, for whatever reason, the fishery will be pushed closer to non-sustainability.

TAC-based management is that it does nothing to resolve the access problem. For this reason, this kind of management system has been baptised "regulated open access". Since neither new entry nor the capacity of existing participants is controlled, there will be nothing to stop the attraction of profits being turned into increased capacity. Assuming that the catch is under control (a big assumption), the stock dimension of sustainability should be achieved - but only at the cost of the other dimensions, particularly the economic one. In a situation where the TAC is more or less fixed each year and fish prices are increasing and/or fishing costs are decreasing, increasing amounts of labour and capital resources will be used to produce the same amount of output. The system will thus generate increasing inefficiency. Only if the break-even point of the fishery is close to the target TAC will it be possible for the management authorities to hold the fishery at the TAC for an extended period of time. Even here it would be important for the fishery to be fairly stable. Otherwise high profits in the good years will tend to attract capacity which may not leave again in the bad years. Regulated

open access significantly worsens the problem of the race for fish. Fishers know that there is only a given amount of fish to be taken before the fishery is closed. A premium is placed therefore on the ability to fish quickly. The system therefore leads to too much investment and to the wrong kind of investment.

A well-documented case of this kind of management (both technical conservation measures and output controls but without limited entry) is the Pacific halibut fishery in North America. Until the 1990s, the fishery was managed using measures (seasons mostly) aimed at not exceeding a given catch (TACs). The management system avoided ecological unsustainability. However, the inherently high profitability of the fishery meant that the fishery continued to attract increased capacity and effort with the result that the available catch was taken more and more quickly. The fishing season declined from something in excess of 300 days per annum to only a few days. Eventually it became apparent that the management system itself was not sustainable because of the extreme effect that it was having on capacity. In recent years, first Canada and then the USA have moved to individual quotas. Therefore, output controls may avoid ecological unsustainability, but they appear susceptible to all other kinds of unsustainability.

Under a properly enforced rights-based management system, access conditions should no longer be an element leading towards non-sustainability.

A market-based approach solves the free and open access problem by removing the free part rather than the open part. The industry remains open to entry to those prepared to fish given the economic circumstances that prevail following the introduction of resource rentals. Although in principle this also should resolve the access problem; the adjustment mechanism is likely to be more rigid than under rights-based systems; and the fishery remains open to the risk posed by asymmetric entry and exit conditions.

Under co-management, access remains a key issue. A co-management system without genuine exclusive access will be vulnerable to increased exploitation by uncontrolled elements that are outside of the system.

### *5.2.1. Asymmetric entry/exit*

One particular aspect of access conditions that may lead towards unsustainability is the frequently observed situation that fishers find it much easier to enter a fishery during good times than to leave it during bad. A commonly-proposed explanation is that fishing capital is both highly specific in its usage and very long lived. It may be very difficult therefore to correct investment mistakes, which may emerge only over a period of time. This problem is referred to as capital non-malleability. The acuteness of the problem will vary under the different management scenarios. For example, a market-based approach where the price to get in the fishery may be relatively high may provide an incentive to stay in the fishery to recover the cost. Of course, asymmetric entry-exit is also linked with profitability, subsidies and a number of other factors.

Ikiara and Odink (2000) analyse the exit decision of Kenyan fishers on Lake Victoria. The main problem in these fisheries is not lack of capital malleability but lack of alternative economic activities leading to fishing being used as an occupation of last resort. In this situation, ease of entry coupled with lack of exit spells gradual decline of the fishery, a situation which has been observed in this fishery since the 1960s. Interestingly Ikiara and Odink find that even in overexploited fisheries, fishers welcome more fishers because, although they add to the negative stock externality, they create positive externalities in terms of expanding the beach area, increasing activity in the area and hence improving price, and

also create the demand for commercial and service activities. In such fisheries, the need for management to ensure the sustainability of fishing is overwhelming.

### *5.3. Uncertainty*

If we had perfect knowledge of the marine ecosystems and of the fishery systems exploiting them, the scientific analyses would indicate what management measures were necessary and when, and with perfect institutions, the correct fishery management decisions would be made and perfectly implemented. Therefore, unsustainability is closely linked to uncertainty.

We consider four main sources of uncertainty:

- Process uncertainty arises from natural variability, such as recruitment variability, not error;
- Observation uncertainty arises from observing only a sub-sample of the population;
- Model uncertainty arises from not having perfect knowledge of how the system functions and;
- Implementation and institutional uncertainty are self-evident.

Estimation uncertainty is a secondary source arising from some or all three of the first sources and it will only be discussed when relevant. Similarly, institutional uncertainty arises from the interactions of the various groups involved in fishery management processes. In this section we will evaluate their effects on sustainability under the scenarios of no management, technical conservation measures, input controls, output controls, rights-based, and market based management.

The **no management** scenario implies that there are no management measures and no fishery management decision to make. It therefore assumes that there is no data collection either for monitoring the fishery or for monitoring the stocks. Consequently, there is also no scientific advice nor any of the other activities associated with modern fishery management. Although there may be uncertainty in the outcome of fishing, uncertainty as described above does not have an explicit influence in the no management scenario.

**Technical conservation measures** suppose a conceptual model linking the adoption of a specific management measure to some desired outcome: if we increase mesh size to let small fish escape it is because we have a conceptual or a quantitative model that these fish will survive, that they will grow and that they will be available to be caught at a later time when they are bigger and more valuable. Model uncertainty is important both in theory and in practice in a management approach using technical conservation measures. In the increased mesh size example, if the injuries suffered by the fish going through the meshes cause it to die, obviously the expected benefits will not materialise, and in fact the measure could inadvertently harm the resource. Similarly, if fish do not grow as expected, possibly because of cold water (process uncertainty) or if they migrate outside of the area fished by those who adopted the increased mesh size, then the measure will not result in the expected increased yield. Model uncertainty is also important for other technical conservation management measures. Permanent seasonal or year-long closures to protect juveniles assume that a large proportion of the juveniles are and will permanently be found in the area closed, and they have similar survival, growth and availability assumption as the regulation on mesh size. Implementation uncertainty is large with technical conservation measures, particularly with respect to gear configuration and there are many ways by which the intent of a regulation can be circumvented (e.g. using larger twine in a larger mesh implies that the selectivity will

remain the same or even decrease). Properly chosen time and area closures can generally be implemented with minimum monitoring, control and surveillance without suffering major implementation uncertainty.

The conceptual model underpinning **input controls** is subject to considerable process uncertainty. "The first limitation of this model is that it considers only one species at a time [...] but no species exists in isolation. Some species are predators, others prey, many are both, and there may be complex food web effects of fishing. Yet this model assumes that changes in population size are due to fishing alone" (Roberts 2000, p. 178). In addition, climatic conditions affect the carrying capacity of the environment and the ability of the resources to respond to exploitation. This means that MSY is not a fixed value and that it can vary as environmental conditions change. Input controls are also directly susceptible to observation uncertainty: in order to estimate the reference points needed to implement input control (MSY and the fishing effort needed to generate it), it is necessary to collect data on catches and fishing effort. In theory, it should be possible to estimate catches reasonably accurately, but often there are reasons not to report all the catches made. Nominal fishing effort is relatively easy to measure (either in number of vessels, number of trips, number of nets set and their length, number of days fished, number of hours fished etc.) but increases in fishing efficiency over time means that the currency of effort in fact changes and one day (or any other unit) fishing in year 1 of the fishery can be expected to exert considerably less fishing mortality than one day fishing in year 10 of the fishery. Similarly, input controls also suffer from model uncertainty. The surplus production curve is often perceived as being symmetrical, but that is not necessarily the case and the shape of the curve describing catches versus fishing effort can take many different asymmetrical shapes. Estimation uncertainty is also important in a management system using input controls because the data are rarely sufficient to unambiguously indicating what model structure is appropriate. Implementation uncertainty can be small or large depending on the currency used to measure effort. Effort measured in number of vessels involved in the fishery is easy to implement, but it is considerably more difficult to control the number of hours fished or the number of hooks set. Input controls also suffer from another form of implementation uncertainty: in order to estimate MSY, it is generally necessary to fish more heavily than the effort that is necessary to generate MSY in order to verify that catches are indeed decreasing and that the effort corresponding to MSY is indeed smaller than the current fishing effort. Ludwig *et al.* (1993) claim that it can be demonstrated from statistical arguments that is impossible to estimate MSY without having to reduce fishing effort. They suggest that "that sustainable exploitation cannot be achieved without first overexploiting the resource" (p 548). The economic nature of input controls (licensing) makes it essential for the management authorities to understand the economic basis of fisher behaviour in order to predict their likely response to management. The dearth of work in this area is more of a problem for management measures such as licensing since quite simplistic views have tended to be taken in their implementation. As a result, such schemes have often failed to live up to expectations.

**Output controls** are normally introduced under various forms of catch quotas. All sources of uncertainty play a role in impeding sustainability under output controls. Process uncertainty makes it very difficult to accurately forecast what catches should be in the future in order to achieve the desired fishing mortality. When general production models, are used to predict catches in the coming years, they are subject to process uncertainty related to recruitment variability and availability of fishes to the fisheries. When age-structured models are used to estimate what catches will generate what fishing mortality, process uncertainty affects a number of the parameters used in the calculation: future recruitment is rarely known with precision and an average value is often used. Similarly, the weights at age of the fish to be

caught in the coming year are not known and can rarely be predicted with any precision. If the recruitment or the weights at age used in the calculations are higher than turns out to be the case in reality, it means that it will be necessary to catch a larger number of fish to reach the quota that was set, and therefore that the fishing mortality will be higher than intended. Observation uncertainty is also considerable under an output control management system because these systems are based on considerably more data than the previous approaches. Detailed information on the age and size composition of the catches are often used and these are subject to considerably variability. As for the previous two sources of uncertainty, model and estimation uncertainty is also considerable under output controls because more complex models are often used as a basis for management decisions in these management approaches. Age-structured assessment models require estimates, or more often assumptions about natural mortality. More often than not, natural mortality is assumed to be constant over time, an assumption that is unlikely to be true when climate and preys as well as predators of the species under investigation both vary. Implementation uncertainties are also significant in output controls system. It is in this system that the incentives to under-report and mis-report catches are highest. Depending on the actual implementation, there may also be incentives to discard and high-grade.

**Rights-based management** would suffer from the same uncertainties as those affecting the chosen mechanism to assign rights.

The economic nature of **resource rentals** makes it essential for the management authorities to understand the economic basis of fisher behaviour in order to predict their likely response to different rental rates. Fishers behavioural responses could be completely different depending on the business objectives that they are trying to achieve. In order to devise an optimal resource rental system, a large amount of economic data is required which is generally not available. In practice it will have to be accepted that resource rentals are unlikely ever to be optimal and seek, instead, to gradually improve the system over time. What might be termed a "satisficing" approach could be adopted, under which the State defines satisfactory returns on its fisheries. As different rates are achieved, the definition of satisfactory can be revised upwards on a trial-and-error basis so that the satisfactory return gradually approaches the optimum. An approach such as this is used by many large-scale business enterprises to maximise their profitability and a similar approach might, perhaps, be made to work in the case of fishing.

The discussion above has dealt mostly with ecological uncertainty, but there are also considerable uncertainties in the other dimensions of the fishery system. The importance of variability/uncertainty in key economic variables will depend on the precise nature of the system.

A key feature of attempts to correct overexploitation is to be able to predict how fishers will respond to various management measures. Fisheries policy is conspicuous by its failure in this area. Until recently, very little work had been undertaken and it remains the case that managers are likely to know more about the dynamics of the fish stock than of the exploiter of the stock. As a result, management measures have often made the overexploitation problem worse, and significantly so in some dimensions of the problem, especially overcapacity.

### *5.4. Improved technology*

A major source of cost reductions in fishing has been improved technology. Many innovations have occurred outside of fishing and have been adapted for and adopted by the fishing industry. Other innovations have been specifically developed in the fishing context.

Under free and open access arrangements where ownership of the resource is conferred only by capture, there will be a tendency for the industry to over-innovate. This is because competition between fishers takes place not merely in the market place but also at sea in the form of an attempt to maximise, or at least maintain, their share of the catch available from the (naturally-limited) fish stock. Fishers may find themselves on a technological treadmill where they are forced to copy successful innovations adopted by other fishers (or see their share of the catch decline). Technological advance will be a double-edged sword for fishers - on the one hand, they must innovate to remain competitive (and because their profits will increase) but on the other hand, as everyone innovates individual innovations will tend to be neutralised in the aggregate and the main overall effect will be increased exploitation rather than increased profit.

In the case of management based on technical conservation measures, improved technology will have a tendency to increase effective fishing effort and therefore exploitation rate. It will therefore push the system at least in the direction of ecological unsustainability.

Because effort has many dimensions whereas licences are necessarily specified in terms of only a few (hopefully key) dimensions, fishery management based on input controls using a licensing system creates an incentive for fishers to attempt to get around the licensing constraint by substituting uncontrolled inputs for controlled ones. The extent to which they are ABLE to substitute inputs is a technical question related to the way in which inputs can be combined to produce effort; the extent to which it is WORTH substituting inputs is an economic question related to the cost of different inputs and the expected pay-off from making changes. But even if it is impossible to substitute inputs in the short term at a reasonable cost, an incentive will be created to innovate so as to avoid the restriction. Due to input substitution problems, fishers already face a strong incentive to innovate under licensing schemes. A policy of improving fishing technology is likely simply to worsen the situation. Managers will then be faced with the problem of either placing additional restrictions on the licences or reducing the number of licences. In practice it is not uncommon to find both things being done. Hence through input substitution a licensing system is likely to be faced with distorted technical choices and an excessive amount of innovation. This activity is likely to dissipate a substantial portion of the resource rent over time, although licences make take on a significant value for a while at least. Under licensing, the race for fish is likely to continue to be a factor leading to unsustainability. The main reason is that the licence does not specify how much can be caught. As a result, each fisher has an incentive to try to catch as much as possible. The problem may not be too severe if the number of licences is appropriate to the state of the resource. But the practical experience is that over time fishing power increases within the licensing constraint and the system has therefore to be supplemented with restrictions on fishing time. The alternative is an on-going process of licence reduction but most States do not have the financial resources necessary to do this. Also the concept of aligning capacity with the state of the resource is seductive in theory but very difficult to achieve in practice - there may be many reasons why fishers choose to have higher capacity than might appear warranted at first sight (e.g. safety at sea, ability to take advantage of variations in fish stock size etc).

Under an output control system using a global TAC, improvements in fishing technology run the risk of encouraging waste and pushing the system towards unsustainability. Individual fishers become more productive, but in the aggregate their investments have no impact on output since they are faced with a fixed output constraint (the TAC). The fact that fishers find themselves on the "technological treadmill" arises from a combination of access conditions and policy. With TAC-based management, fishers are unable to invest in fish in the sea and there is therefore intense competition to extract fish before someone else does.

Under a market-based management system, if rentals are specified in terms of fish prices, then there should be no distorting effect in the choice of fishing technology. If however they are imposed via taxes on inputs then fishers can be expected to reduce use of the taxed input to the extent that input substitution is possible. Although this could introduce some elements of non-sustainability, it could also be used to achieve subsidiary objectives - for instance, a fuel tax would reduce fuel consumption and save on the nation's fuel bill.

Fishing technology policy has often been an important element along the road to unsustainability. Many countries have followed a policy of encouraging improved fishing technology in situations where management systems are unable to control effort. In addition to affecting the amount of technology, policy measures have distorted the choice of technology. The most obvious example is where subsidies have favoured capital over labour. Ironically this has often occurred in situations where governments are also trying to achieve employment objectives. In many countries, there has been a policy of trying to identify the "ideal" fishing technology. This policy seems misplaced. It has committed governments to certain kinds of technology, giving them a kind of moral responsibility to support the technology (subsidies) when times are hard. It seems more appropriate that the choice of production technology should be the fishers. This also provides an example (amongst many) of conflicting policy objectives. On the one hand, the management authorities try to control mortality basically by requiring the fishing industry to use less-than-efficient technology whilst on the other attempts are made to encourage individual fishers to become more productive.

### *5.5. Lack of economic alternatives*

For small-scale fisheries in particular and where there are no or few alternative economic activities, fishing may become an unemployment sink. The condition emerges (as aptly summarised by MacKenzie 1979) that "fishermen are not poor because they are fishermen, they are fishermen because they are poor". If there are few opportunities for alternative employment (i.e. low opportunity cost of labour), particularly as local populations increase in size, then under conditions of free and open access overcapacity and overfishing are often inevitable. A very similar situation arises, where there is a substantial body of labour not suitably skilled for alternative employment. A kind of equilibrium is likely to emerge only when returns have been severely depressed by a reduction in catch rates due to a decrease in stock size.

Technical conservation measures have the same effect as with the no-management situation described above because they do not address this issue.

Input controls through licensing offers some potential for improvement because it offers the potential for resource rents to be extracted or capitalised (partly at least) into the licence price. Such rents could be used to invest in the local economy so as to create economic alternatives. Many things could be done. Among the most obvious are training and re-training for fishers in order to give them alternatives and infrastructure development to increase the attractiveness of the region to other investors. Whether such investments are forthcoming depends to some extent on who decides what to do with the rent. One argument in favour of extraction by the Government is that there is more certainty that the rent will be used in a local context. If the rent is left with the private sector, there is no guarantee where the investments may be made. On the other hand, if the money is left with the Government there is perhaps less guarantee that the rent will be used productively (rent-seeking behaviour may be a serious problem) whereas the private sector is more likely to be guided by the returns available.

The relationship between the lack of economic alternatives and output control management is complicated, but, with perfect implementation, output controls should mean that the lack of alternatives will not impact the exploitation rate of the fishery, but the links with improved technology may. In addition, the lack of alternatives may encourage non-compliance and the government may be unwilling or unable to do anything about this in situations where it has nothing else to offer. Finally, where there is a lack of alternatives, an economically-efficient management system may generate strong feelings that it is inequitable, thereby increasing the social dimension of non-sustainability.

This may be particularly the case when output controls are combined with rights-based management. Rights-based management could result in improving ecological and resource sustainability. Economic theory tends to assume that displaced capital and labour can do something else but in practice policy-makers may be faced with trade-offs between social, economic and resource sustainability. Even if it is recognised that the true problem is to develop alternatives, politically there may be no choice in the short-run but to make such a trade-off. An output-based rights system offers the potential to generate sustainable rents which could be used to fund investments in the local economy so as to create economic alternatives. However, they also offer the potential to capitalise and remove the main livelihood source in a region. Careful management of them is therefore required.

The problem of the lack of economic alternatives will complicate market-based management. First, the management authorities may be unwilling to introduce rental-based systems at all in this situation, and even if they do introduce them, they may be reluctant to push the system very far. As a result, the system may fail in practice to remove much of the pressure on fish stocks. In principle, resource rentals collected offer the potential to invest in fishers in order to increase their economic alternatives. However, such an approach requires that management authorities invest first and collect the rents later. This order of events is not usually attractive to the authorities.

### *5.6. User participation and compliance*

When there is little consultation with resource users concerning the management instruments and regulations that must be put into place, users are seen as exploiters of the resource whose activities must be regulated if the resource is not to be endangered. As a result, the regulations may have little legitimacy from the users' point of view, leading to poor compliance and expensive enforcement. Fishery regulation may turn into a game wherein users feel it acceptable to cheat the system.

Non-compliance with fisheries regulations is a major factor in unsustainability. A key issue therefore is what explains compliance and what must be done about it. It seems obvious that the solution is not simply to be found in ever stricter enforcement. The issue is to investigate how the system might be designed in a way which gives fishers incentives to comply and then to look at the enforcement required.

Under input controls through licensing, licences are a use right, and user participation can be expected to commence under such a system. However, it may not go very far. There may still be little consultation with resource users concerning the management instruments and regulations that must be put into place. Users may well continue to be seen simply as exploiters of the resource whose activities must be regulated if the resource is not to be endangered. Licences also may suffer therefore from a lack of legitimacy, leading to poor compliance and expensive enforcement. Many licence programmes suffer from both non-

compliance with regulations and exploitation of loopholes in definitions. Simply increasing enforcement may not be a realistic alternative.

Under a TAC-based management system, there is a tendency to see resource users as an important part of the problem for which regulations are required. Even where there is consultation, it may be difficult therefore to generate a sense of legitimacy for the regulation among the fishermen. They may feel that TAC controls (especially reductions) place them in a position where they have no choice but not to comply if they are to survive. This will lead to expensive compliance problems and will tend to undermine the system. There will tend to be an antagonistic relationship between managers and fishers, resulting in a lack of co-operation, because they have conflicting goals and interests. Managers seek to conserve the stock whereas the management system gives fishers the perverse incentive to catch what they can in the time available (before the TAC is exhausted or the season closed). There will be no natural tendency to comply with the system. Only if enforcement is adequate will the system work.

Because output-based rights are likely to deliver good results in terms of economic efficiency, the incentives to under-report and mis-report catches will be great. Both of these factors may lead to non-sustainability in that they may cause overfishing and errors in stock assessment. On the other hand, if rights are transferable fishers should have an incentive to comply because the price of rights will be influenced by expected future profitability of the fishery. But there will always be a need for enforcement effort coupled with dissuasive penalties. Perhaps the most pernicious threat facing output-based rights systems is the problem of targeting behaviour by the fishers. Under most such systems, although the aim is to restrict fishers' catch to a certain amount, in practice the requirement is that fishers do not land more than a certain quantity. As a result, fishers may be faced with an incentive to ensure that what they do land is of the highest value possible. This problem of so-called "high-grading" may lead to substantial discarding, leading to underestimates of true fishing mortality and hence overestimates of the TAC.

Under a market-based system, as with all costs, there will be an incentive for enterprises to reduce their resource rental burden so far as possible. An appropriate institutional structure will have to be established to ensure compliance at reasonable cost. One of the key issues regarding the use of such a system is whether it can be made to work without all, or most, of the benefits of reduced exploitation being used up as extra costs required to enforcing the system.

Large resource rents are likely to be available to a rental-based system. Depending on the precise way in which the system is implemented, it is to be expected that rent-seeking behaviour will emerge. The cost of administering the system could become excessive. On the catching side, illegal landing will become very profitable as will mis-reporting if rental rates vary substantially by species. Enforcement will be essential.

### *5.7. Desire for stable fishing opportunities*

Both policy-makers and the fishing industry like to have predictability and stability, preferably in the form of fixed annual catch plans. TACs set under a conservation-based management system may give the impression of such stability. But attempting to maintain stability in the face of ecological risks (or uncertainty) is a dangerous strategy. There is likely to be strong political pressure for stability (e.g. EU plans for multi-annual TACs). But the greater is the ecological uncertainty, the greater the need for flexibility.

Under licensing the desire of policy-makers and the fishing industry for predictability and stability is likely to lead to a greater threat to sustainability than under conservation-based management. The problem is that stability will not be in the form of catch but in terms of numbers of licences and of their operation. In the face of ecological uncertainty, it would be essential to be flexible to respond to ecological changes, but it may prove difficult to be so under a licensing system.

A threat may be posed to community sustainability in certain areas if rights are transferred away from those areas. The problem arises because many people associated with, or even dependent on, the fishing industry may not qualify for an allocation of rights. Even though therefore those who have been allocated rights may gain in transferring them elsewhere, the transfer process may create losers in the system. A simple fix is to restrict transferability but this also restricts the potential benefits from the system.

### *5.8. Subsidies*

Subsidies are a common feature of fisheries policy that may impact sustainability. As a general rule, subsidies reduce fishing costs as well as related infrastructure and service costs. They thereby increase profitability and hence the demand to participate in the fishery. The way in which this increased demand materialises itself will depend on the management system. Under management systems that do not control access (no management, technical conservation, overall output controls), subsidies are likely to push the fishery towards non-sustainability.

Under licensing the initial effect will probably be the price of licences. But it will also strengthen the incentive to substitute inputs (leading to a net investment in unrestricted inputs) and hence the threat to push the fishery closer to a non-sustainable position. Under a rights-based system, subsidies should not affect exploitation levels since their effect will be upon the price of rights (assuming transferability). With a system based on resource rentals, the issue will presumably not arise since it does not seem to make sense to charge rentals whilst giving subsidies (except perhaps on a targeted basis to achieve specific goals).

Providing subsidies also has the general drawback that it creates expectations that the industry will be rescued from financial crises. As a result, investments may be forthcoming that would not otherwise appear, i.e. fishers will undertake riskier investments than otherwise.

It may be possible to design some subsidy programmes that impact capacity in a way that enhances sustainability (e.g. buybacks) but the evidence suggests that this is very difficult to achieve (Holland *et al.*, 1999).

### *5.9. External factors*

An exploited fishery may face a broader set of external factors than an unexploited fish resource. To begin with the exploited fishery will be faced with the same indirect effects - i.e. a deliberate decision might be made that the unsustainability of the fishery is a price that has to be paid in order to achieve some other benefit, or the fishery might simply bear some of the cost of other activities that impinge upon it.

In an exploited fishery, it might be expected that more consideration will be given to external impacts, than in the unexploited case, because of the economic implications. But there is no guarantee that this will be the case. The generally poor economic state of unmanaged fisheries

may make it difficult to convince policy-makers in other sectors to take the needs of the fishery sector seriously. In this case, the lack of management itself might be considered a factor of unsustainability. It will tend to result in a situation where:

- There is an institutional void for the fishery sector
- There is a lack of rights for the fishery sector with no way for the sector to express the value of the resources which are lost

Issues such as habitat degradation and pollution may be more serious if considered from a fishery perspective, rather than from fish resource one. Even if such problems do not imperil the survival of the fish resource, they may threaten the fishing activity based upon it. And the industry may also be vulnerable to competition for space in the coastal area where rising property prices associated with increasing coastal population may make it impossible for fishers to maintain their activity in an area. They may find both housing and dock space too expensive in traditional areas.

External threats are likely to remain a significant threat to non-sustainability under an output-based rights system. Although fishers can be expected to defend their valuable rights combating external threats, and although those posing the external threats may be forced to take into consideration the impact that they may have on the fishery, the practical situation may not be simple. First, identifying sources of pollution may be difficult and taking appropriate legal action expensive and uncertain. Second, rights may not necessarily infer any right to the protection of critical habitat for the fish population.

### *5.10. Policy objectives*

The fishing industry does not exist in a vacuum. Even an unmanaged fishery will be affected by broad policy decisions. In many cases, the industry is a small, but possibly locally important, part of the macro-economy. The industry may be affected by Central Government's macroeconomic policy, particular in its regional and trade aspects. Depending on circumstances, Governments may be prepared to sacrifice sustainability goals in order to meet pressing macroeconomic requirements. The obvious example is widespread unemployment in coastal areas which may be a prime motivator for increased fishing activity. Likewise in isolated areas, Governments may be prepared to tolerate non-sustainability in some dimensions in order to limit de-population problems.

The overcapacity generated by a TAC-based management system may be viewed positively in such circumstances. Take a hypothetical example of a fishery producing 100 tonnes of fish per annum. At the beginning of the system, the fishery employed 500 people, but over time capacity has increased and 1 000 are now employed taking the same output. Those who take an efficiency perspective will emphasize that twice as many resources are now used as are necessary. But it is possible to take a different perspective and argue that where previously the fishery could only support 500 people, it is now capable of supporting 1 000. Moreover, since the stock is held at its highest long-run productivity, the system produces the maximum number of jobs in processing, although with the disadvantage that all landings may occur within a very short period of time.

The fishing industry will be subject to the same general economic rules as the rest of the economy. Sometimes these rules may encourage a build-up of capacity. For instance in the case of capital depreciation allowances, cases have been documented where fishers were given a clear incentive to over-invest by the general tax rules concerning depreciation.

## *5.11. Equity issues*

Equity is not an issue under the no-management nor, generally speaking, under technical conservation measures. Licensing, if fisheries become very profitable, is the first fishery management stage where equity may become an issue. Economically efficient management methods such as output-based rights will result in large resource rents being generated in the fishery. If such rents are not extracted by the management authorities (for instance in the form of resource rentals), they will be capitalised into the price of rights. Since rights have typically been allocated for free where they have been introduced, a significant amount of wealth has effectively been transferred from the community at large to rights holders. The scale of this transfer usually becomes apparent only once trading of rights begins, by which time it is may be difficult to do much about it. If this process is considered inequitable, then whole system may come under challenge.

There is also a risk that rights may become monopolised, which may represent a threat to community sustainability. If monopolisation is felt to be inequitable, it may also pose a threat to the sustainability of the management system itself since it can be expected that those outside the system will attempt to undermine it.

Rentals also are likely to face equity issues. It may be felt that it is unfair that fishers should be asked to pay for the use of a natural resource to which they have traditionally had access for nothing. Moreover, if managers wait for the fishery to be in a poor condition before introducing management, then again it is likely to be considered unfair because instituting rentals will effectively drive some fishers out of business. In order for sustainable arrangements to emerge, it will be necessary to give serious thought to the way in which rentals are introduced.

## *5.12. Factors of particular relevance for co-management*

### *5.12.1. Group objectives*

It is expected that under co-management the user group will focus on sustainability but this is a testable hypothesis. It will be important to investigate whether the group is not pursuing objectives (e.g. employment, social equity) that may prevent effective effort control and the avoidance of excess capacity. Otherwise, the group could find itself over time drifting towards unsustainability.

### *5.12.2. Incentives of group members*

The incentives of individuals within the group may not be all that different to those existing under State management systems. As is the case with the State, the results of management will depend on the management methods used by the group. Often such systems seem to rely on effort control of one kind or another. In such cases, the group may find that input substitution becomes a problem.

### *5.12.3. Need for overall view of resource*

In general the scale of operation of user groups is likely to be less than the scale of the resource. It will be essential therefore for the management authorities (State) to take an overall view of the resource. Otherwise, a number of threats to sustainability exist. Perhaps the most probable is that efforts made by the user group to manage their share of the resource simply benefit those outside (depending of course on the precise nature of the resource being

managed). Members of the user group are unlikely to be committed to it on a sustainable basis in the face of such dissipation of the benefits that they expect to receive from their efforts.

An alternative possible scenario is that the user group could overexploit one important aspect of the fishery. Where user groups represent small-scale fishers, their activities are often close inshore where they may be exploiting juveniles or brood stock. If their exploitation is high on these elements of the stock, they could put pressure on the fishery taken as a whole. It is conceivable that this could pose a threat to the sustainability of the resource base, although more likely the threat will come to the sustainability of the management arrangements and the users who depend on them.

*5.12.4. Weak groups*

User groups may be unable to play the role assigned to them. The co-operation within the group may be inadequate. Such co-operation will be required on a permanent basis. The State will have to monitor different groups to ensure that they do not break down over time, particularly because this has tended to be the fate of many traditional management systems.

*5.12.5. State role*

Under co-management, user groups tend to be considered the primary element for resource management. But the State clearly continues to have a critical role in view of the limitations of local collective action.

By far the most important role of Government is to ensure that appropriate local systems of resource management operate in a legal framework which provides legally enforceable recognition of their identity and rights. The State must also provide the framework within which these rights can be enforced. The systems face three broad threats against which they must be able to protect themselves: from within, from encroachment by neighbouring groups or external intruders, and from other economic sectors (e.g. pollution, tourism).

At the same time the State will have to protect individual members of the system, providing a conflict-resolution mechanism whenever conflicts cannot be settled within the community. It may also have to intervene in conflicts between groups.

In addition, as mentioned above, the State will be responsible for overall fishery policy and will have to monitor overall resource usage within which the local system operates.

If the State is unable or unwilling to play these roles, then a co-management system is likely to be unsustainable.

*5.12.6. Need for an adjustment mechanism*

Where there are overlapping groups and/or stocks, a key issue will be how to change the allocation of rights over time as relative efficiencies change. Also, consideration might have to be given to the issue of what to do if the group no longer represents the best management alternative. How are rights to be transferred away from the group? Sustainability depends on having an adjustment mechanism but often the expectation seems to be that the management problem has been solved once user groups have been established. This is an unrealistic view, especially taking a long-run perspective. Systems that do not have an adjustment mechanism will be inherently unsustainable.

## 6. Discussion by management scenario

In section 5, we discussed some of the main factors that might lead to unsustainability under different management arrangements. The matrix presented in Appendix 1 presents a fuller set

of such factors. It is clear that the relative importance of factors changes from management system to management system. In this section, we briefly discuss the main factors of unsustainability that seem likely to affect each system. The discussion is limited to the cases where exploitation is taking place, the no-exploitation scenario having been covered in section 3.

### *6.1. No management*

A situation of "no management" defines a particular set of institutional arrangements - basically free and open access. Under such arrangements, we argue that there are many economic and social factors that will tend to push the fishery towards increasing exploitation over time, eventually reaching overexploitation and unsustainability in at least one of its components. It must be stressed that there is no single factor that leads to unsustainability. It is combinations of factors, which are important. The principal ones under no management appear to be: the conditions of free and open access, sufficient profitability, resource variability and various ratchet effects (due to asymmetric entry/exit conditions and lack of economic alternatives).

The key factor is the free and open access to the resource associated with no management. However, in itself free and open access does not necessarily lead to overexploitation (and hence to non-sustainability). A second necessary condition is that the fishery should be (or should be expected to be) sufficiently profitable for exploitation to be high enough.

Profitability may increase over time for a number of reasons. Some of these are associated with the fishery itself: increased demand due to rising population, decreased costs due to technical progress. Others are related to the general economic environment. Increasing profitability under free and open access will lead to increased exploitation.

The situation may be worsened by various factors. Due to their naturally regional or local scope, many fisheries exist in areas where alternative economic activities are few and far between. As a result, fishers may be prepared to continue fishing even though the returns that they receive become very low. This problem of low opportunity costs is often accompanied with asymmetric entry into and exit from the fishery. Good times attract yet more effort (labour and capital) into the fishery but bad times do not necessarily result in it leaving again. The result is that exploitation in the many (but not all) unmanaged fisheries tends to ratchet up over time, gradually approaching unsustainability. As exploitation increases, the fishery becomes increasingly vulnerable to shocks.

Unmanaged fisheries will also be vulnerable to the natural variability of fish resources and external threats from other activities. Experience strongly suggests that the basic dynamics of unmanaged fisheries push them towards unsustainability, which is of course a primary reason many fisheries are now managed.

### *6.2. With management*

The fishery management processes in place today have rarely emerged as a result of a grand design. Instead, they have often evolved over time in an attempt to resolve problems as they have arisen. The result is often a patchwork of more or less complementary measures. Moreover a belt and braces approach tends to be taken with administrations reluctant to remove one set of regulations as others are introduced. Consequently, the management

systems tend not to be as watertight as may be suggested by the discussion below but often exist in parallel.

Nonetheless the development of fishery management over the past 50 years or so has broadly been to move from one system to the next. Not all countries, and certainly not all fisheries, have followed the same path, but there does seem to be a fair degree of consistency in the process. Broadly speaking, the fishery management process has evolved from little state intervention; to the implementation of technical conservation measures followed either by input and/or output controls. In recent years, great emphasis has been laid on the need to ensure that fishers face appropriate incentives so that they perceive it to be in their own interest not to over-exploit fish resources. In this context, one trend is towards more economically-oriented management systems, based either on use rights or on resource rentals (or, still quite rarely, a combination of the two). Another trend is towards the implication of stakeholders in the management process, especially with the development of co-management.

### *6.2.1. Technical conservation measures*

The principal feature of technical conservation measures is that they focus on one dimension of sustainability: the fish stock. Other dimensions are ignored. There is some evidence that technical conservation measures may be effective at controlling fishing mortality, even if this is not the objective. On Georges Bank, the closure of large areas where catch per unit of effort was high is believed to have contributed significantly to the substantial decrease in fishing mortality estimated to have occurred in the second half of the 1990s.

Under technical conservation measures, the key factor is free and open access, but the nature of the adjustment mechanism is different. Assuming that the conservation measures are complied with, it may be possible to avoid ecological unsustainability. As a result equilibrium will be restored not by falling stock size but by increased entry depressing individual catch rates. If profitability is sufficiently high, this process may be taken to extremes. With technical conservation measures, unsustainability may also be reached because of natural variability, and overexploitation. Such measures generally fail if used alone because they do not control access to the resource.

As the limitations of technical conservation measures become apparent, the fishery management authorities typically react in one of two ways: either they try to restrict the number of participants in the fishery (licensing) or they try to restrict the catch that is taken (TAC).

### *6.2.2. Input controls*

Limiting entry, usually by licensing, is a step in the right direction compared to technical conservation measures. Where the system works, it may allow exploitation rates to be controlled over some period of time, thereby reducing vulnerability to natural variation. External factors may continue to be a significant threat to non-sustainability. However, if licenses are transferable, they will take on some value and this may help to protect the fishery against external threats. The main reason to expect some improvement is that licensing introduces the notion that the fishing sector has some rights. The fact that such rights take on a significant monetary value may encourage fishers to defend them by combating external threats, and it may also force those posing the external threats to take into consideration the impact that they may have on the fishery, particularly once the legal position of licence holders has been tested through the judicial system.

However, input-based rights tend to be vulnerable to a number of problems that may increase risks of unsustainability. These problems are discussed in this section.

A major problem is that licensing controls only one dimension of capacity: new entry. It leaves open the possibility for those who are already in the fishery to increase their effort within the capacity constraint imposed by the licence. The extent to which they can do this depends on the input substitution possibilities within the production function. One situation where this might be avoided is if the number of licence holders is small so that co-operative behaviour can emerge.

A significant practical difficulty in many cases is that licensing is not introduced until significant overcapacity has built up in the fishery. As a result it is not uncommon to find that the number of licences issued is far greater than warranted by the available catch. Licences are usually issued free on the basis of participation in the fishery over some reference period. As a result, some fishers who are no longer involved in the fishery qualify for a licence. Since licences are free they understandably take up the licence in the hope that it will take on some value in the future. Where such licence overhang is significant, management may be extremely difficult because attempts to reduce capacity will activate some inactive licences, leading to maintained, or even increased, exploitation levels.

Because the licence does not specify how much can be caught, the race for fish is likely to continue to be a factor leading to unsustainability. This problem is likely to worsen over time as input substitution proceeds. The standard way to address this and the previous issue is through a licence reduction programme but most States do not have the financial resources necessary to do this. In fact, many Governments come under pressure to increase, rather than decrease, the number of licences, especially if these are available free, as is often the case.

### *6.2.3. Output controls*

Output controls through overall TACs do not resolve the key problem associated with free and open access. If the TAC is respected, it may be possible to maintain the stock (or avoid biological unsustainability). But economic pressures will remain and equilibrium will be restored not by falling stock size but by increased effort (new and existing fishers) depressing individual catch rates. If profitability is sufficiently high, this process may be taken to extremes. The fishery system may also be threatened because it is likely to become vulnerable to shocks. Given the very high effort and capacity that can emerge, it may become difficult to predict the impact of effort.

In most practical implementations, it has been found that output controls, by themselves, or in combination with technical conservation measures and input controls, have not been sufficient to protect the resources and ensure sustainability.

### *6.2.4. Rights-based*

Rights-based fishery management is expected to improve the situation with respect to many factors of unsustainability, but several problems remain.

Under ITQs and exclusive zones, the free and open access problem is largely resolved. Threats to sustainability come from a variety of factors. A prime difficulty for ITQs is the difficulty of calculating accurate TACs, especially if fishers are highgrading or are mis-reporting catch. External threats in terms of habitat loss and pollution will remain important.

Nonetheless, ITQs with adequate monitoring, control and surveillance, offer the possibility of improvement in terms of resource sustainability. As a result other dimensions of sustainability come more to the fore under such systems, in particular the problem of community sustainability and perhaps the sustainability of the management system itself. A difficulty facing ITQs or other rights-based systems is to ensure that there is an appropriate definition of management units. In particular, such units have to be sufficiently encompassing. Some

elements of fishing may prove difficult to bring within the management system. If for political or other reasons it is not possible to prevent their increase, then over time they may undermine the system. Obvious examples are recreational fishing in the case of developed country fisheries and small-scale fishers in developing countries.

Until recently, there had been little progress in defining appropriate use rights. As a result fishers have had little incentive to conserve their own resource base; and they have been exposed to threats from outside the fishery sector (especially in the coastal area). In other words, the institutional arrangements create economic conditions which leave fishers with no interest in sustainability.

Output-based rights systems are likely to have an important economic impact. It is important to realise, however, that much of the impact will be in terms of wealth, rather than income, generation. In practice, there often seems to be an expectation that such rights-based systems will help achieve the frequently-cited policy objective of increasing incomes. If such schemes are to contribute to such a goal, then very careful consideration must be given to the design of the system, paying especial attention to the distinction between income and wealth effects. Not doing so may lead to the creation of systems that are considered inequitable and hence are unlikely to be sustainable (Whitmarsh 1998, Cunningham 1994).

### *6.2.5. Market-based*

Under a market-based fishery management system, the access is no longer free and fishers are forced to take into account the inherently valuable nature of the resource that they are using. Various factors may threaten sustainability under a rental-based system. As with ITQs, rentals are likely to represent a great improvement in terms of resource sustainability, and other dimensions of sustainability are likely to be more important. However, fishers may have less of a direct stake in the fishery than under say an ITQ system. As a result, it will be essential for the management authorities to deal with external threats.

Given the value of fisheries resources, a resource rental system can be expected to generate significant amounts of revenue. Depending on the precise institutional arrangements that are established, such revenue might encourage rent-seeking behaviour of various kinds, going from simple bribery and corruption to unnecessary expenditure on the trappings of office for the institutions charged with running the system. An appropriate system of checks and balances will be required to ensure that rent-seeking behaviour does not use up a substantial portion of the benefits of the system.

Resource rentals may lead to an increase of the price of fish for poor consumers and this may impact upon food security. However the issue is complicated. If the fishery is overexploited, then resource rentals may lead to falling supply and higher prices in the short term, but to increased supply and lower prices in the longer term. The issue becomes then one of a trade-off between short and long term priorities.

### *6.2.6. Co-management*

Co-management is somewhat different to the other management systems considered, in that it provides an institutional framework within which such systems (or the instruments that constitute them) might operate. Many of the threats to sustainability identified in the previous sections are likely to be relevant also to co-management, depending on the precise management choices made. Co-management is likely for instance to be vulnerable to external threats (e.g. habitat loss) and to internal threats (e.g. input substitution).

In addition, co-management faces some threats related to the sustainability of the system itself. Somewhat ironically, perhaps the most important element is that the State should

identify and play its role properly in terms of defining legally-enforceable use rights, and in taking an overall view of resource exploitation. The most difficult long-term issue facing co-management systems appears to be to devise effective adjustment mechanisms that will allow smooth transitions as economic and other circumstances change.

## 7. Conclusions

It is easy to conclude that without some form of explicit institutional arrangement, either through local or national institutions, fisheries will progressively become unsustainable, at least under one component. In general, they will become economically unsustainable before ecological unsustainability becomes a possibility, but there are cases of low productivity species (deep water slow growing species) where exploitation rates may increase sufficiently rapidly for the fisheries to remain economically sustainable while being biologically unsustainable. Also, low productivity species may become threatened even as by-catch species.

The almost exclusive focus on ecological sustainability (biological) in the past is probably one of the contributing factors to the currently perceived limited success of fishery management. Implied in that focus, was the understanding that fishery management would succeed in rebuilding all stocks of predators and preys at their optimal sizes and maintain them there. This was overly ambitious (hubristic) because climatic variability (whether natural or induced by human activities) may have a more important effect. It might therefore be preferable to act on those components of sustainability where fishery management is likely to have a more direct effect, i.e. the socio-economic, community and institutional components.

The institutional arrangements with the highest probability of avoiding the three components of unsustainability are those involving meaningfully interested parties in the decision-making process but also in the implementation, and to develop an appropriate incentives structure. Command and control approaches have therefore limited potential outside of very specific situations. Therefore co-management appears a promising approach, whatever method of management (technical conservation measures, input controls, overall output controls, use rights, market measures) is chosen.

Modern fishery management, particularly in the context of the implementation of the precautionary approach, has become closely associated with harvest management strategy and control rules evolved from control theory. Saila (1997) notes that although "conventional control theory has been a tremendous success where the system is very well defined, such as in missile and space station guidance" the theory is perhaps not appropriate to control complex systems such as commercial fisheries. Amongst the reasons, he mentions that the precise structure of the system is virtually unknown and that there are no reliable models of the process to be controlled. He suggests that success in fishery management requires a system that can handle qualitative information and uncertainty, in a straightforward, transparent and not computationally intensive manner. This is not the direction in which most fishery management processes are heading.

In addition to seeing sustainability in terms of components, it is also possible, indeed important, to consider it in terms of scale. There is a need to decide at what scale sustainability is to apply. The traditional scale is the exploited fish stock and the fishery that depends upon it, but there are many alternatives (e.g. the exploited ecosystem, the overall fishery sector, or the national economy in general). This question can only be decided by considering the appropriate macroeconomic role of the fishery sector (and the fisheries that

comprise it). A similar question exists in terms of time scales: over what period is sustainability to apply? Is it acceptable to operate the system unsustainably in some element over a particular period, provided that an irreversible situation is not created?

No fishery management system aims at unsustainability. Yet, it is rarely possible to avoid all of its components: when ecological unsustainability is avoided, it is often at the expense of the other components, and vice-versa. Does this mean that all fisheries are going to eventually become unsustainable under some or all of the components of sustainability? Or is unsustainability a normal statistical expectation of the fishery management system failing some of the time? Is a given percentage of unsustainable fisheries a normal feature of a given fishery management system due to the slowness of the control and feedback mechanisms?

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## Appendix 1: Factors of unsustainability

| Factor | Sub-factor or comment | Exploitation, but no management | Technical conservation measures | Input controls | Output controls | Use rights | Market measures |
|---|---|---|---|---|---|---|---|
| Profitability | Increased profitability leads to increased desired exploitation rates | Exploitation rates simply increase leading to overcapacity and to eventually overfishing | Technical conservation measures have no effect on desire to increase exploitation rates in profitable fisheries. May improve exploitation pattern and help ecological sustainability. | Increased demand for rights pushing up their price rather than the exploitation rate. May be attempt to increase exploitation within the constraint of the number of licenses. | Competitive TACs lead to a race for the fish. Exploitation rates increase up to TAC. If TAC binding, unnecessary investment in capital then follows, with the possibility of the TAC being caught in extremely short periods of time. | Increased demand for rights pushes up their price rather than the exploitation rate. May be attempt to increase exploitation within the constraint. | Increased profitability offers opportunity to increase tax revenues rather than the exploitation rate. |
| | Profitability can increase for a number of reasons. Amongst the main ones are increased demand, linked among other things to international trade, variation in landings and decreased input costs. Input costs may decrease for a number of reasons, such as decreased fuel costs, but increases in efficiency are particularly important. They are covered separately under improved technology. | | | | | | |
| Resource rent | | Neither extracted nor capitalised, so perceived by fishers as profits, driving the fishery to higher exploitation rates | Measures may create rents in short run, but this will encourage increased effort (new entry or existing participants). Resource rents dissipated | Resource rents become capitalised into price of licenses. Provides opportunity to extract rents if desired. If not may give rise to equity issues. Possible rent-seeking behaviour (input substitution) | Similar to technical conservation measures. TACs may create rents in short run, but this will encourage increased effort (new entry or existing participants). Resource rents dissipated | Resource rents are capitalised in the price of rights. Provides opportunity to extract rents if desired. If not may give rise to equity issues. Possible rent-seeking behaviour (high-grading) | Tax systems offer possibility to extract rents and to reduce exploitation rates. |
| Access conditions | | Under no management, access is free and open leading to overexploitation. Often observed that it is easier to enter fishing than to leave (applies both to capital and labour) which results in a ratchet effect progressively increasing exploitation rates. | Similar effect as no management. | Input controls by licensing has generally been introduced once exploitation rates are too high, or it has become uneconomic to fish. | Overall TAC controls, without input controls, will lead to new entrants. In combination with input controls, it may lead to increased fishing efficiency because of the race for fish. | Similar to above on resource rent. | |

## Appendix 1: Factors of unsustainability

| Factor | Sub-factor or comment | Exploitation, but no management | Technical conservation measures | Input controls | Output controls | Use rights | Market measures |
|---|---|---|---|---|---|---|---|
| Uncertainty | The nature of uncertainty, its effects, and whom it affects varies according to the management scenario. Under no management, natural variability in stock sizes and markets are the main sources of uncertainty. As management progresses, more sources of uncertainty are introduced. Uncertainty is an important factor leading to unsustainability. If the fishery management agency had perfect knowledge, it would make the correct decisions all the time and would also implement them perfectly. | | | | | | |
| | Species resilience | Species have different resilience to exploitation, and within species, different populations will also have different resilience. The resilience of individual species is not known, and it is likely to vary over time with climatic changes. Some species with low reproduction rates, such as shark and rays, are generally expected to be less resilient than more prolific species such as cod and herring. No management implies that all species will eventually become overexploited and perhaps depleted. Once management starts, it generally aims at avoiding depletion of a target species. In multispecies fisheries, low productivity by-catch species could become depleted even in the absence of a directed fishery. | | | | | |
| | Scientific assessment | Uncertainty in the scientific assessments have no effect under no management. Assessments may even not exist. | Under technical conservation measures, the expected effects of the measures adopted may not materialise because of assessment uncertainties. | There are considerable uncertainties about the fishing effort necessary to generate the Maximum Sustainable Yield or a fraction of it. These play a direct role towards unsustainability under input controls. | Catch based output controls are subject to considerable assessment uncertainties, not only with respect to current population parameters and status, but even more so with respect to future ones. | Depends on the nature of the rights. | Depends on the nature of the market shares. |
| | | In output control fishery management systems, TACs are often adjusted yearly in order to keep fishing mortality below an accepted threshold or to aim at a target. In order to do so, practice is often to assess current stock status and project future trajectories. This requires information on future recruitment, future weights at age, future exploitation rates, future natural mortality etc.. | | | | | |
| | Ecosystem functioning | Sustainable development, in particular the principle of intergenerational equity, calls for letting future generations having similar options to those we presently have. This requires that the functioning of ecosystems, if not all their constituents be protected. There is limited understanding of how this can be achieved, and what exactly needs to be protected. Failure to protect ecosystem functioning leads first to ecological unsustainability, but eventually, under all components. | | | | | |
| | Management units | This is particularly relevant for ecological unsustainability. The aim is to manage fisheries on the basis of meaningful biological units that should respond similarly to management measures. Too large a management unit, comprising several distinct biological units, may run the risk of depleting some of the more easily accessible ones. Too small a management unit could lead to confusion about the developments of the unit. Small and large in the sentences above are relative to the real nature of the biological unit. Problems can be expected when a management boundary is not adequate for all dimensions (ecological, socioeconomic, community and institutional). | | | | | |

## Appendix 1: Factors of unsustainability

| Factor | Sub-factor or comment | Exploitation, but no management | Technical conservation measures | Input controls | Output controls | Use rights | Market measures |
|---|---|---|---|---|---|---|---|
| **Uncertainty** continued | Data requirements | By definition, no data are needed in support of management. | Relatively limited data are needed in either time or space once the potential effect of a management measure have been validated. | Long time series of data are needed to evaluate MSY and the effort corresponding to MSY. Continued monitoring is needed to assess changes in efficiency. | Large quantities of detailed data are required on a continued basis. | Depends on the nature of the rights. | Depends on the nature of the market shares. |
| **Targeting behaviour** | | Targeting may lead to discarding of non-target low value species. | Mostly similar effect as no management or made worse by some measures (e.g. fish size limits). | Discarding of low-value non-target species. | If TAC binding, may lead to discards of both target and by-catch species. | High-grading of catch likely in order to maximise value of landed catch. | Discarding of low-value non-target species. |
| **Input substitution** | | No incentive to use other than economically optimal input combination | Control of one or more inputs will encourage substitution | Input-based rights likely to encourage expansion of uncontrolled inputs | If TAC binding, race for fish worsens encouraging investment in speed | Output-based control should mean choice of optimal input set | Depends on how tax applied in detail. Attempts to tax effort may have similar effects to input-based rights |
| **Asymmetric entry/exit (Lack of alternatives)** | | Capital non-malleability and/or low opportunity cost of labour (due to lack of economic alternatives) may lead to ratchet effect. Entry attracted in good years but does not exit in poor years. | Since access not controlled, short term improvements will attract new entry leading to longer run problems (depending on exploitation levels) | May make it difficult and/or expensive to achieve licence reductions if licensing introduced once capacity built up | Since access not controlled, short term improvements will attract new entry leading to longer run problems (depending on exploitation levels) | May lead to conflict unless equity issues carefully considered | May mean that very high rentals would be required to reduce effort levels |
| **International trade opportunities** | Will work through profitability, hence impact similar | Improved trade opportunities may be a threat to sustainability because of impact on short-term profits | Threat | Opportunity but potential longer term threat through input substitution | Threat | Opportunity | Opportunity for management authorities but potential threat if rentals not adjusted |
| **Rent-seeking behaviour** | | N/A | N/A | Likely to be encouraged, mainly via input substitution | N/A | Likely to be encouraged mainly via highgrading | Depends on institutional arrangements. Can be expected to be a problem |

## Appendix 1: Factors of unsustainability

| Factor | Sub-factor or comment | Exploitation, but no management | Technical conservation measures | Input controls | Output controls | Use rights | Market measures |
|---|---|---|---|---|---|---|---|
| User participation and compliance | | N/A | Situation varies according to management systems. Frequently antagonistic relationship between managers and fishers. Compliance poor and enforcement expensive | Give fishers a stake in the fishery. Compliance likely to be good. | Because output controls often lead to overcapacity, compliance often poor, especially when output reductions required because fishers cannot survive economically on reduced catches. | Give fishers a stake in the future of the fishery. Expectation that compliance and peer-based enforcement will improve, but highgrading appears a problem. | Depends on institutional arrangements. A significant proportion of benefits may disappear in compliance and enforcement costs. |
| Choice of unsustainability | | Whatever the management system, policymakers may choose to trade-off sustainability in one area in return for benefits in another | | | | | |
| Fishing technology policy | States have often sponsored technological improvements | N/A | Technical advance tends to undermine management system | Policy of improving technology likely to push the fishery towards less sustainable situation, unless accompanied by mechanisms to reduce number of licences | Technical advance tends to undermine management system leading to increased catch up to TAC and increased capacity once constraint binds | Investment only if costs reduced or revenue increased. Policy can be better targeted once rights exist | May be a problem if rentals difficult to adjust |
| Subsidies | Often an important element of technology policy but may be used more generally. Main effect to reduce fishing costs | N/A | By lowering costs, subsidies will tend to increase exploitation levels. | Subsidies reduce costs and hence profits. This will push up licence prices, encouraging input substitution. Example of buybacks as subsidy - difficult to design so as to be effective | By lowering costs, subsidies will tend to increase exploitation levels up to TAC constraint. Once constraint binds, encourage investment in redundant capacity | Subsidies will affect the price of rights rather than exploitation levels. Possibility to use selective subsidies (eg environmentally friendly gear) | If fishery being managed by taxation, it would not make sense to have a policy of general subsidies, although targeted subsidies still possible |

## Appendix 1: Factors of unsustainability

| Factor | Sub-factor or comment | Exploitation, but no management | Technical conservation measures | Input controls | Output controls | Use rights | Market measures |
|---|---|---|---|---|---|---|---|
| Lack of understanding of fisher behaviour | | N/A | Fishers have generally changed their behaviour in order to minimise the impact of management measures. | Failure to understand fisher behaviour has often led to simplistic views of possible results of licence programmes. | In the absence of sufficient enforcement (the rule rather than the exception), output controls have led to misreporting, dumping, discarding and high-grading in order to maintain income despite the restrictions. | Need to understand economic basis of behaviour, especially if rights to be used to achieve goals other than economic efficiency. Need to avoid unintended consequences. | Use of taxes should provide correct incentives for fishers, but still need to understand behaviour to be able to predict response. |
| Desire for stable fishing opportunities | | N/A | N/A | If stability is interpreted in terms of number of licences, may be too much capacity locked into the fishery | May lead to attempt to maintain TACs in face of ecological (and other) variability and uncertainty | Unwarranted attempts to maintain TACs may be resisted by fishers concerned about the value of their rights | Once fishing effort brought into line with available opportunities, some possibility to stabilise by varying taxes to compensate for other changes |
| Failure to distinguish between income and wealth | | N/A | N/A | Depending on the precise nature of the licensing scheme, licences may take on a substantial value. The main effect will be on wealth, not on income. Confusion of these effects may lead to inequitable outcomes and unsustainable management systems | N/A | Effect similar to input controls but economically efficient systems (such as individual catch rights or spatial monopolies) are likely to have an even greater wealth effect, on a sustainable basis. Need for clarity on resource ownership, use rights, equity and sustainability of management system. | Royalties also will influence wealth and income. Need to clarify resource ownership issue, and who is to benefit from the resource and in what way. |

## Appendix 1: Factors of unsustainability

| Factor | Sub-factor or comment | Exploitation, but no management | Technical conservation measures | Input controls | Output controls | Use rights | Market measures |
|---|---|---|---|---|---|---|---|
| General economic policy | | Fishery responds to general economic incentives - e.g. taxation rules may allow depreciation of capital assets at rates providing incentive to over-invest | Fishery responds to general economic incentives - e.g. taxation rules may allow depreciation of capital assets at rates providing incentive to over-invest | Although fishery will still respond to general economic incentives, existence of rights should remove incentive to over-invest. Depending on precise nature of rules, could still be some distortion | Fishery responds to general economic incentives - e.g. taxation rules may allow depreciation of capital assets at rates providing incentive to over-invest | Although fishery will still respond to general economic incentives, existence of rights should remove incentive to over-invest. Depending on precise nature of rules, could still be some distortion | In setting tax levels in fishery, need to take overall fiscal situation into account. Could still be some distortion |

## Appendix 1: Factors of unsustainability

| Factor | Sub-factor or comment | Exploitation, but no management | Technical conservation measures | Input controls | Output controls | Use rights | Market measures |
|---|---|---|---|---|---|---|---|
| Equity issues | Regional shifts | N/A | N/A | If licences are transferable, they may not continue to be held in the same regions as before, leading to threats to community sustainability in some areas. | N/A | Similar problem to input controls but may be more severe in case of transferable catch rights because relatively easy to transfer these to existing vessels in other areas. | N/A |
| | Monopolisation of rights | N/A | N/A | A system of transferable licences will open the possibility for some monopolisation. This could threaten community sustainability and the management system itself if it is felt to be inequitable | N/A | Similar problem to input controls but perhaps more severe because may be easier to monopolise catch rights. | N/A |
| | Political acceptability | N/A | General acceptability to use such measures | Political will to introduce licences but often too late. Less will to reduce number of licences in line with resource availability | Output controls often accompanied by unwillingness to reduce TACs in line with scientific advice | Much resistance to introduction of use rights | Generally unacceptable (except for foreign fishers). Problem that rentals may have to be increased when fishery already stressed. |

## Appendix 1: Factors of unsustainability

| Factor | Sub-factor or comment | Exploitation, but no management | Technical conservation measures | Input controls | Output controls | Use rights | Market measures |
|---|---|---|---|---|---|---|---|
| **Beggar-my-neighbour policies** | In the case of capacity reduction | N/A | N/A | Impact of capacity reduction programmes by foreign States depends on how licences allocated. If new licences easily available at low cost, availability of cheap capacity may lead to increased exploitation | Capacity reduction programmes may lead to excess capacity being exported | Fishers will invest in cheap capacity only if costs lower. But some potential conflict because only some sectors likely to have access to cheap capacity (e.g. industrial versus small-scale fishers) | Fishers likely to be interested in cheap capacity |
| **Habitat degradation** | Activities of other sectors (or sometimes the fishery sector itself) may destroy key habitat | Under these arrangements, both habitat degradation and pollution are likely to be serious sources of non-sustainability for the fishery sector. The value of the fish resource is likely to insufficiently identifiable. | | If licences are transferable and take on some value, fishers are seem likely to have a more clearly identified self interest in protecting the resource and their activity. | Issue likely to be similar to first case. Fishery management agency must take the lead in defending the sector. | Similar to input controls. Valuable use rights should provide an incentive (and the legal basis) for the sector to seek to protect itself. | Economic benefits of resource exploitation will go to the State (as custodian) in the form of royalties. Up to the State to ensure that such royalties are not undermined. |
| **Pollution** | Activities of other sectors (or sometimes the fishery sector itself) may lead to pollution | | | | | | |

DISCUSSION PAPER 2

# REVIEW OF FACTORS OF UNSUSTAINABILITY IN FISHERIES: RELATIONSHIP TO INTERNATIONAL FISHERIES INSTRUMENTS

A discussion paper prepared for FAO by

Michael W. Lodge

## INTRODUCTION

The purpose of this document is to attempt to identify whether the main factors contributing to unsustainability and overexploitation in fisheries are addressed in international fisheries instruments and, in so far as they are addressed, to analyze how and in what way they are addressed. The present document is complementary to an analysis of the key factors contributing to unsustainability and overexploitation prepared for FAO as a basis for discussion by Stephen Cunningham and Jean-Jacques Maguire.

In recent years the international legal and policy framework for fisheries management has been substantially improved as a result of action taken both within FAO and within the broader United Nations system, as well as at the regional level. These actions have resulted in a complex web of both "hard" and "soft" law provisions giving rise to a variety of rights, duties and obligations. While considerable progress has been made by States and within regional fishery bodies in the implementation of international fisheries instruments, there is a need for continuous review and assessment of the progress that has been made with a view to a more efficient application of the provisions of those instruments.

The present document aims therefore to provide a general review of international fisheries instruments and their relationship to the major factors identified in the FAO study which might be used as a basis for a more detailed assessment of the opportunities, constraints and priorities for implementation of existing instruments as well as the identification of possible gaps.

## INTERNATIONAL FISHERIES INSTRUMENTS

International efforts to regulate ocean fisheries have a long history. Indeed, disputes over access to fisheries resources lay behind some of the first attempts to regulate the use of the oceans. Before the modern era, the greatest issue was allocation of rights to fish in particularly crowded fishing grounds. Since the twentieth century, however, the emphasis has been on the regulation of overfishing and overinvestment.

Prior to the widespread adoption by coastal States of the 200 nautical mile exclusive economic zone (EEZ) in 1976-77, ocean fisheries were an open-access common property resource, open to all. While governments could regulate their own fishers, no single government had the right to regulate all fishing and consequently regulation of all fishers depended upon cooperation between governments. As problems of overfishing became more apparent, governments responded by establishing international bodies charged with making

joint decisions about managing common property resources, one example of such a body being the North Pacific Fur Seal Commission, established in 1911.

It was not until the 1950s, and the First and Second United Nations Conferences on the Law of the Sea that efforts were made to codify the international law of the sea and create a uniform system of ocean governance. While the First Conference failed to agree on the limits of the territorial sea, it nevertheless made some progress in relation to the issue of fisheries conservation and management by adopting in 1958 the Geneva Convention on Fishing and the Conservation of the Living Resources of the High Seas. The 1958 Convention contained implicit recognition of the fact that the fish resources of the oceans were not in inexhaustible supply and that some measures had to be taken for their conservation and management. However, although there was a general exhortation for cooperation among all those who fish on the high seas, it was largely left to flag States to determine and enforce any measures for conservation and management of the stocks.

The establishment of 200 nautical mile exclusive economic zones in the mid 1970s as a result of the Third United Nations Conference on the Law of the Sea led to a fundamental shift in the normative framework within which international fishery bodies operated. Most ocean fisheries were no longer open-access. Instead, property rights were attributed to coastal States, with varying consequences for conservation and management of fish stocks. Indeed, while enclosure of the oceans was thought to be a necessary and inevitable step towards more efficient management of fisheries resources, it in many cases resulted in more rapid depletion of stocks as coastal States, some of which lacked the experience and capacity to manage their fisheries resources, sought to maximize the economic benefits from exploitation of the EEZ.

The basis for the modern legal framework for ocean governance is the 1982 United Nations Convention on the Law of the Sea. In respect of fisheries, the most significant new contribution of the Convention was the establishment of a legal regime for the exclusive economic zone. This is contained in Part V of the Convention (articles 55 – 75). Within the EEZ, the coastal State has sovereign rights for the purpose of exploring and exploiting, conserving and managing natural resources, whether living or non-living. At the same time, however, the coastal State is obliged under article 61 to determine the allowable catch of living resources in its EEZ and to ensure, through proper conservation and management measures that the maintenance of such resources is not endangered through overexploitation. Measures adopted by the coastal State shall also be designed to maintain or restore populations of harvested species at levels which can produce the maximum sustainable yield, as qualified by relevant environmental and economic factors.

Article 62 of the Convention formulates the duty of the coastal State to promote the objective of optimum utilization of the living resources of the EEZ and elaborates upon the powers of the coastal State to regulate access to its EEZ. Articles 63 and 64 deal with the special situation of shared stocks, straddling fish stocks and highly migratory fish stocks.

The other important contribution of the Convention was to preserve the freedom of high seas fishing while at the same time making the right to fish on the high seas subject to the provisions of articles 116 to 119, which impose a duty on all States to conserve the living resources of the high seas and to cooperate with one another in the conservation and management of the living resources of the high seas.

By the early 1990s it was recognized that the Convention regime was inadequate to prevent depletion of the world's fish stocks. In particular, it became apparent that the ambiguity in the

provisions in the Convention relating to the conservation and management of straddling and highly migratory fish stocks and high seas fishing needed to be addressed if overexploitation was to be avoided. At the United Nations Conference on Environment and Development in 1992, the problems affecting fisheries were identified succinctly in Chapter 17 of Agenda 21 as "unregulated fishing, overcapitalization, excessive fleet size, vessels reflagging to escape controls, insufficiently selective gear, unreliable databases and lack of sufficient cooperation between States."

As a result, the international community has made strenuous efforts since 1990 to address the problems of fisheries management through a range of "hard" and "soft" law instruments. These take the form of, on the one hand, legally-binding treaties of a global nature, the most notable of which is the United Nations Agreement for the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA), and, on the other hand, non-binding declarations and resolutions issued by a range of fora, including the UN General Assembly and the FAO Conference. The most comprehensive non-binding instrument that has been adopted during this period is the FAO Code of Conduct for Responsible Fisheries (CCRF), which is itself made up of a number of separate, but linked, documents, and which is continuing to evolve through the formulation of international plans of action on issues of immediate concern.

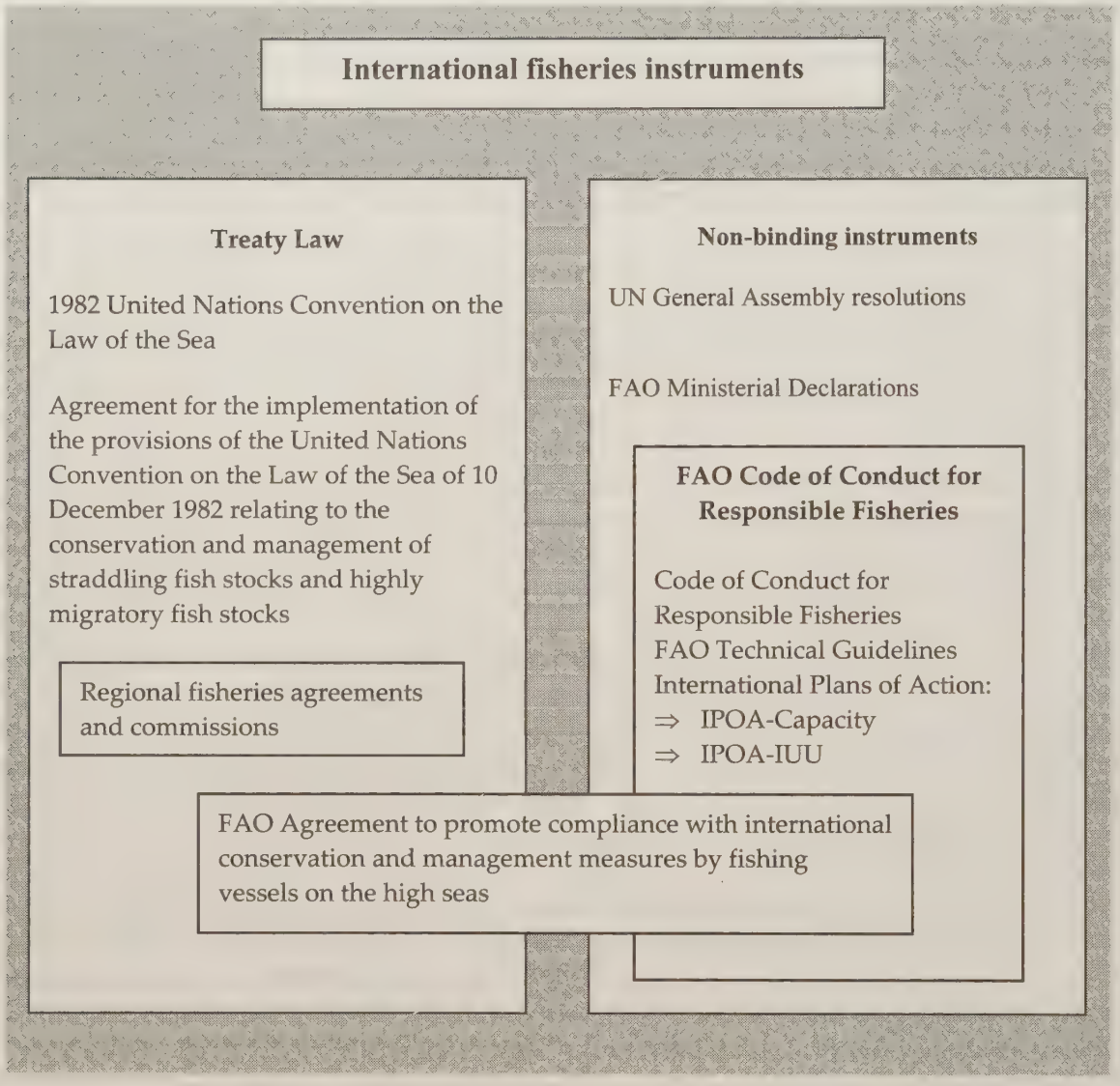
The growing use of soft law instruments to address issues of immediate concern has been one of the most interesting developments in international fisheries law in the past decade. These instruments, while clearly not intended to give rise to binding legal obligations, are often drafted in a quasi-legal style and reflect many of the principles found in binding legal instruments such as the 1982 Convention and the UNFSA. Some instruments, such as the UN General Assembly resolutions on large-scale pelagic driftnets, have had a greater impact on the conduct of States than their actual legal status would suggest. Others, such as the CCRF, having been adopted by a formal decision of the FAO Conference, may well be reflective of international "best practice" and relevant as an aid to the interpretation of legal obligations specified elsewhere. Indeed, in the case of the CCRF, the Preamble to the UNFSA itself gives recognition to the importance of "responsible fishing".

Conversely, while one of the fundamental tenets of treaty law is that only the parties to a treaty can be bound by the legal obligations contained in that treaty, one of the consequences of the close linkages between the various international instruments is that there is much repetition of key concepts and provisions and States may well give implicit consent, on a voluntary basis, to certain "obligations" which they would not otherwise commit themselves to in the context of a binding treaty. For example, article 7 of the CCRF substantially reproduces, in non-binding form, many of the provisions found in Part III of UNFSA relating to the structure and functions of regional fisheries management organizations. Thus it might well be argued that even those member States of FAO that have not become party to UNFSA have agreed at the international level to apply the same principles and standards on a voluntary basis through the CCRF.

For the purposes of the present paper, a selection has been made of those international fisheries instruments which have most relevance to the subject-matter of the workshop. The current status of the instruments selected is shown in Annex 1. A brief description of each of the instruments will be given, followed by an analysis of whether the key factors contributing to unsustainability are, in fact, addressed by those instruments. In addition, given the importance attached to institutional factors, consideration is given to the need to reinforce existing regional fishery management bodies.

The relationships between the international fisheries instruments considered in this paper are shown in figure 1 below.

**Figure 1: Schematic representation of relationships between international fisheries instruments**


International fisheries instruments
Treaty Law
1982 United Nations Convention on the Law of the Sea
Agreement for the implementation of the provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the conservation and management of straddling fish stocks and highly migratory fish stocks
Regional fisheries agreements and commissions
Non-binding instruments
UN General Assembly resolutions
FAO Ministerial Declarations
FAO Code of Conduct for Responsible Fisheries
Code of Conduct for Responsible Fisheries
FAO Technical Guidelines
International Plans of Action:
⇒ IPOA-Capacity
⇒ IPOA-IUU
FAO Agreement to promote compliance with international conservation and management measures by fishing vessels on the high seas

## A. United Nations Agreement for the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks

The UNFSA was adopted in 1995 following three years of negotiations. It entered into force on 11 December 2001 and there are, to date, 30 States Parties. As the title of the Agreement implies, it is intended to implement the provisions of the 1982 Convention relating to straddling fish stocks and highly migratory fish stocks. The broad objective of the Agreement is "to ensure the long-term conservation and sustainable use of straddling fish stocks and highly migratory fish stocks". While the provisions of the Agreement apply primarily to

straddling fish stocks and highly migratory fish stocks in areas beyond national jurisdiction, article 5 of the Agreement also establishes new principles for management which are of general application both within and beyond areas under national jurisdiction. These principles include provisions on minimizing pollution, protection of biodiversity in the marine environment, the development of appropriate technologies in support of fishery conservation and management and taking measures to prevent or eliminate overfishing and excess fishing capacity. In addition, article 6 (which sets out the precautionary approach) and article 7 (which emphasizes the need to ensure compatibility between conservation measures established for the high seas and those adopted in areas under national jurisdiction) are expressly made applicable in areas under national jurisdiction.

In addition to establishing new rules and principles for management of straddling fish stocks and highly migratory fish stocks which serve as a blueprint for fisheries conservation and management in general, the UNFSA also makes two other significant contributions to the development of international law. The first of these concerns the role of regional fishery bodies in the conservation and management of straddling fish stocks and highly migratory fish stocks. The Agreement recognizes that, in the final analysis, neither coastal States nor distant water fishing States can manage the stocks in isolation. There must be a framework through which coastal States and fishing States can cooperate to establish management regimes and agree on problems of allocation and effort limitation. In this regard the provisions of the 1982 Convention have been elaborated upon. The roles and responsibilities of regional fisheries management organizations have been clarified and made more meaningful as a forum for management of shared resources. Where a competent regional fisheries management organization exists, States should either become members of the organization or they should agree to apply the conservation and management measures established by the organization. The second major area of development relates to the increased emphasis on the responsibilities of flag States for their fishing vessels. Not only have the requirements for flag State responsibility been further developed and enumerated, but also they have been supplemented by the measures that can be taken by members of regional organizations in cases where the flag State is unable or unwilling to take effective action itself. Thus, through a combination of the mechanisms provided in the Agreement and the measures to be adopted through regional organizations, an important gap in the effective application of conservation and management measures has been filled. This is an important innovation and a major development in international law.

## B. FAO Code of Conduct for Responsible Fisheries

The CCRF was adopted by the FAO Conference in October 1995 after three years of elaboration through working groups and technical consultations. It should be noted that much of the work on the CCRF was carried out in parallel with negotiations in the United Nations on the UNFSA. There is, therefore, considerable overlap and consistency between the two instruments. The need for a code of practice or guidelines on responsible fishing practices had been recognized by FAO's Committee on Fisheries in 1991 during the lead-up to the UNCED and it was considered that the CCRF would be an important contribution to achieving sustainable fisheries development.

The CCRF covers all aspects of fisheries, including capture, processing and trade in fish and fishery products, fishing operations, aquaculture, fisheries research and the integration of fisheries into coastal area management. Its broad objectives, which are set out in full in its article 2, are to:

- establish principles and international standards of behaviour for responsible fishing and fisheries activities;
- serve as guidance for States in establishing or improving the legal and institutional framework for fisheries;
- promote cooperation in research, conservation and management;
- promote trade in fish and fishery products; and
- provide standards of conduct for all persons involved in the fisheries sector.

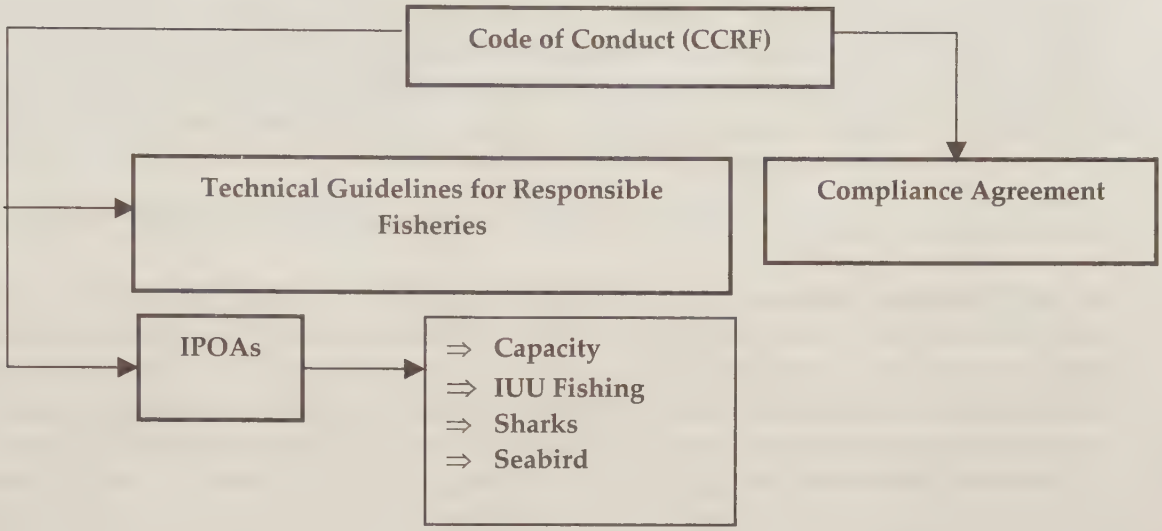
The overall purpose of the CCRF is to facilitate structural change within the fisheries sector so that stocks are exploited in a long-term, rational and sustainable manner. Although aimed particularly at governments and their national fisheries administrations, it is also recognized that regional fishery bodies have a special role to play in implementing the CCRF where fish stocks are shared.

At the core of the CCRF are the nineteen general principles set out in article 5. These provide, amongst other things, that management measures should be aimed at ensuring the level of fishing effort is commensurate with the productive capacity of fisheries resources and emphasize the importance of a precautionary approach to conservation, management and exploitation of living aquatic resources.

The CCRF is voluntary in nature, although articles 1 and 3 make it clear that certain parts of it are based on relevant rules of international law, including those reflected in the Convention. It is to be interpreted and applied in conformity with the Convention and consistent with the relevant provisions of the UNFSA.

The CCRF is not a static instrument and has been supplemented by a number of other instruments elaborated by FAO. These are shown schematically in figure 2. These instruments include the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (the "FAO Compliance Agreement"), which is a legally-binding agreement that was in fact adopted in 1993 before the CCRF had been completed, but nevertheless forms an integral part of the CCRF and a series of non-binding technical guidelines and international plans of action. Since its adoption, the provisions of the CCRF have been supplemented by more detailed technical guidelines issued by FAO in consultation with experts from around the world. To date, guidelines on fisheries management, fishing operations, the application of the precautionary approach, aquaculture development and inland fisheries have been issued. The guidelines have no legally-binding effect and are intended to serve as technical guides to the interpretation and application of the various provisions of the Code. In addition, FAO has elaborated, "within the framework" of the CCRF international plans of action on the management of fishing capacity, for the conservation and management of sharks, for reducing incidental catch of seabirds in long line fisheries and, most recently, to prevent, deter and eliminate illegal, unreported and unregulated (IUU) fishing.

**Figure 2: Elements of the Code of Conduct**




The various subsidiary elements of the CCRF will be considered briefly below.

*FAO Compliance Agreement*

The FAO Compliance Agreement was developed by FAO as an urgent response to the Declaration of Cancún (1992), which called upon States to "take effective action consistent with international law, to deter reflagging of fishing vessels as a means of avoiding compliance with applicable conservation and management rules for fishing activities on the high seas". This call for action was subsequently reiterated in Agenda 21.

Following a rapid negotiation process, the FAO Compliance Agreement was approved by the FAO Conference on 24 November 1993 as "an integral part" of the CCRF. The Agreement will enter into force on the deposit with the Director-General of FAO of the twenty-fifth instrument of acceptance.

The Agreement aims to elaborate upon the provisions of article 94 of the 1982 Convention by making them specifically applicable to fishing vessels on the high seas. The most important element in the agreement is the emphasis given to the concept of flag State responsibility. There is a general obligation on the flag State to take such measures as may be necessary to ensure that vessels flying its flag do not engage in any activity which undermines the effectiveness of international conservation and management measures. The flag State must not allow any of its vessels to be used for fishing on the high seas unless they have been authorized by the relevant national authorities to be so used. Authorized fishing vessels must fish in accordance with the conditions of the authorization.

All Parties to the agreement undertake not to grant authorizations to any fishing vessel which has, within the previous three years, had its authorization to fish on the high seas suspended or withdrawn by its former flag State. This provision is designed to prevent the practice of re-flagging fishing vessels to escape controls. There are some exceptions and limitations to this obligation, particularly where it can be shown that there has been a *bona fide* change in the

ownership of the vessel, or where the new flag State, taking into account, *inter alia*, the circumstances in which the authorization was withdrawn, makes a determination that to grant the authorization would not undermine the object and purposes of the agreement.

Parties are required to take enforcement measures against their flag vessels which act in contravention of the agreement and sanctions must be of sufficient gravity to be effective in securing compliance and to deprive offenders of the benefits accruing from their illegal activities. For serious offences, such sanction should include refusal, suspension or withdrawal of the authorization to fish on the high seas.

*IPOA-Fishing Capacity*

The IPOA-Fishing Capacity is a voluntary instrument which elaborates upon the CCRF by setting out urgent actions and mechanisms to promote its implementation. Such actions include assessment and monitoring of fishing capacity and the preparation of, and implementation of, national strategies as well as the exchange of information on issues related to the management of fishing capacity. The immediate objective of the IPOA-Capacity is to achieve world-wide an efficient, equitable and transparent management of fishing capacity.

*IPOA-IUU Fishing*

The objective of the IPOA-IUU Fishing is to prevent, deter and eliminate IUU fishing by providing all States and regional organizations with "comprehensive, effective and transparent measures by which to act". The IPOA lists a series of measures under the headings of State responsibilities, flag State responsibilities, coastal State measures, port State measures, internationally-agreed market-related measures, research and regional fisheries management organizations. Like the other IPOAs, the IPOA-IUU Fishing reiterates and elaborates upon the provisions of the CCRF and other instruments, including the UNFSA.

## C. Other non-binding measures

A number of other "soft" law instruments of a non-binding nature may be considered. These include the various UN General Assembly resolutions on large-scale pelagic driftnets, as well the Kyoto Declaration and the Ministerial Declarations adopted by FAO.

Although recommendatory in nature, UN General Assembly resolution 44/225, on the problem of large-scale pelagic driftnets, had a significant impact on international fisheries, not least as a forerunner of the application of a precautionary approach to fisheries. The resolution called for a moratorium on large-scale pelagic driftnet fishing in the absence of sound scientific evidence showing that the practice had no unacceptable adverse impact on the sustainable management of marine living resources. Since the adoption of resolution 44/225, the UN General Assembly has considered an annual report on the status of implementation of the resolution and has also extended its interest to other key problems of global fisheries management, including fisheries by-catch and discards and unauthorized fishing in zones of national jurisdiction. A list of the relevant UNGA resolutions appears in Annex 1.

Of perhaps less global significance than the UN General Assembly resolutions, are the Kyoto Declaration and the Ministerial Declarations adopted by FAO. The Kyoto Declaration was one of the outcomes of the International Conference on the Sustainable Contribution of Fisheries to Food Security, held in 1995. While the Declaration has clear links to all the other international instruments under consideration, its focus is primarily on the problem of a

growing world (human) population and the need to secure food for present and future generations.

The Rome Consensus on World Fisheries, adopted in 1995, and the Rome Declaration on the Implementation of the Code of Conduct for Responsible Fisheries, adopted in 1999, are hortatory declarations of a political nature and have no precise legal status. They are not decisions of the FAO Council of Conference and, while they draw attention to a number of issues of global concern, it would appear that the primary objective of these instruments was to endorse the implementation of strategies at the highest level.

## FACTORS CONTRIBUTING TO UNSUSTAINABILITY

The FAO study identifies the various factors of unsustainability in fisheries and considers their relative impact under each of six different management scenarios. For various reasons it is exceptionally difficult to make any precise correlation between the factors identified in the FAO study and the provisions of international fisheries instruments. One clear reason for this is that many of the factors identified are of an economic nature, often driven by external factors which are not necessarily reflected in international fisheries instruments. Furthermore, as should be obvious from the scope of the study and the narrative above, no attempt has yet been made to address systematically the factors of sustainability within the context of an international fisheries instrument. Such instruments far more often develop as a response to political issues than a scientific attempt to address specific economic, social or biological problems. In many cases, therefore, the best that can be done is to use international fishery instruments to create or facilitate the right environment to make the best-informed choices in fishery management decision-making. In particular, international fishery instruments are a critical tool for the establishment of appropriate institutional arrangements, which in turn have a direct effect on sustainability.

The following brief analysis, presented in tabular format, is useful as an indicator of the extent to which the factors identified in the FAO study are dealt with in the context of international fishery instruments.

| *Factor of unsustainability* | *Extent to which addressed in international fisheries instruments* | *Citations* |
|---|---|---|
| **Profitability** | Not addressed explicitly. However, the study points to the need for an appropriate institutional/management framework to prevent increased profitability from leading to overfishing and/or overcapacity. These institutional factors are addressed by UNSFA, CCRF and IPOA-Capacity. | |
| Trade aspects | While CCRF addresses the issue of responsible international trade in fish and fish products and the IPOA-IUU Fishing contains a section on internationally-agreed market-related measures designed to promote international trade in fish and fish products harvested in a sustainable manner and to deter or eliminate trade in products derived from IUU fishing, no | |

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| | instruments deal with the macroeconomic environment (currency exchange rates, general economic policy) dealt with in the FAO study. | |
| **Access conditions** | Access conditions for most commercial fisheries have been substantially changed, in particular high seas fisheries and fisheries for straddling and highly migratory stocks. Freedom of fishing has been drastically curtailed. Where a competent regional fisheries management organization exists, States should either become members of the organization or they should agree to apply the conservation and management measures established by the organization (UNFSA, article 8). | UNFSA, article 8. |
| | New general principles for management under UNFSA are also applicable in the EEZ and include the precautionary approach, which is elaborated in detail (article 6 and Annex II). UNFSA also introduces target reference points and limit reference points in place of MSY. | UNFSA article 5, (general principles), article 6 (precautionary approach), article 5 |
| | CCRF recognizes long-term sustainable use is the overriding objective of conservation and management. | CCRF, article 7.2 (management objectives) and 7.6 (management measures) |
| | One major problem that remains under any management scenario is new entrants/non-parties. | |
| | Asymmetric entry/exit problem not addressed | |
| **Sources of uncertainty** | | |
| (a) Inadequate data | Both UNFSA and CCRF emphasize the critical importance of collecting, compiling and disseminating timely, complete and accurate catch and effort data, promoting scientific research in support of fishery conservation and management and taking into account the best scientific evidence available when making management decisions. | UNFSA, article 5 and Annex 1; CCRF, article 7.4. |
| | UNFSA contains detailed standard requirements for collection and exchange of data (Annex I). | UNFSA, article 5 and Annex I. |
| | CCRF also recognizes that responsible fisheries requires the availability of a sound scientific basis to assist fisheries managers and other interested parties in making decisions (article 12) | CCRF, article 12. |

| | | |
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| (b) Limits to fish stock size | Not addressed. | |
| (c) Variability of fish stocks | Not addressed, except in the sense that the precautionary approach is incorporated as a central feature of both the UNFSA and CCRF. | UNFSA, article 6; CCRF, article 6.5, 7.5. |
| (d) Limitations to biological modeling | The key problems identified in the study (i.e. failure to look at spatial stock structures, narrow approach, inappropriate models) are specifically addressed in UNFSA and CCRF, which both contain multi-species (ecosystem) approach to fisheries management. | |
| | Thus UNFSA contains specific requirements (as part of application of precautionary approach) to take into account uncertainties in size and productivity of the stock, impacts of fishing activities on non-target and associated or dependent species (article 6), as well as emphasizing the need to apply compatible measures throughout the range of the stocks (article 7). | UNFSA, article 6. |
| | CCRF also contains detailed provisions on data gathering and management advice (article 7.4), the precautionary approach (article 7.5) and fisheries research (article 12), as well as emphasizing the need for effective fisheries management to be concerned with the whole stock unit over its entire area of distribution (article 7.3). | CCRF, article 6.4, article 7, article 12. |
| (e) Inadequate understanding of fisher behaviour | CCRF requires interests of fishers to be taken into account (article 7.2.2.) and requires sufficient knowledge of social, economic and institutional factors to be developed through data gathering, analysis and research (article 7.4.5.). | CCRF, article 7.2, 7.4. |
| (f) Insecure use rights | Addressed indirectly through changes in access conditions to EEZ and high seas resources (see *Access Conditions*). | |
| (g) Complexity | Both UNFSA and CCRF recognize complexity of fisheries activity and need for integrated approaches. | CCRF, article 2, article 6. |
| **Improved fishing technology** | All aspects of fishing technology use addressed extensively in CCRF (article 8) and should act as a constraint upon management choices (see also *Inappropriate gears* and *Habitat destruction* above) | CCRF, article 8 |
| Inappropriate gears | Strong emphasis placed on the need to develop and use selective fishing gear, methods and practices so as to minimize waste, discards, | UNFSA, article 5; CCRF, article 6.6, 7.2, 8.5 |

| | | |
|---|---|---|
| | catch of non-target species and impacts on associated or dependent species. CCRF provides that selective and environmentally safe fishing gear and practices should be further developed and applied, to the extent practicable, in order to maintain biodiversity and to conserve the population structure and aquatic ecosystems and protect fish quality (article 6.6). | |
| **Lack of economic alternatives** | Not addressed. | |
| **Compliance factors** | Substantial progress made in addressing the problems of IUU fishing. UNFSA and FAO Compliance Agreement elaborate upon the responsibilities of flag States; UNFSA provides mechanism for regional and subregional cooperation in enforcement, including boarding and inspection regimes and jurisdiction of port States; CCRF elaborates upon duties of flag States and port States; IPOA-IUU Fishing sets out principles and measures to prevent, deter and eliminate IUU fishing. | UNFSA, Parts V and VI; FAO Compliance Agreement; CCRF, article 8.2, 8.3, IPOA-IUU Fishing. |
| **External factors** | | |
| Habitat destruction | CCRF (article 6.8) recognizes the need to protect and rehabilitate all critical fisheries habitats in marine and freshwater ecosystems, such as wetlands, mangroves, reefs, lagoons, nursery and spawning areas. Fisheries interests are to be taken into account in the multiple uses of the coastal zone and integrated into coastal area management, planning and development (article 10). | CCRF, article 6.8, 6.9, 8.7, 8.8, 10 |
| Degradation of the environment | CCRF refers to the need to protect the marine environment and atmosphere. | CCRF, article 6.8, 6.9, 8.7, 8.8. |
| | Refer also to the 1982 Convention, Part XII, on protection and preservation of the marine environment. | 1982 Convention, Part XII. |
| **Subsidies** | Not adequately addressed, despite being identified in Agenda 21 as a major cause of unsustainability. Covered in part in CCRF, article 7.1.8; 7.6.3 and UNFSA Preamble. | UNFSA, Preamble; CCRF, article 7.1.8; 7.6.3 |
| **Policy objectives** | All international fishery instruments under survey have as their sole or primary objective sustainable use of fish resources. However, there is no agreed definition of "sustainability". | UNFSA, article 2; CCRF, article 2, article 6. |
| | The objective of UNFSA is "to ensure the long-term conservation and sustainable use of straddling fish stocks and highly migratory fish | |

| | | |
|---|---|---|
| | stocks" (article 2).<br><br>The objectives of the CCRF, inter alia, are to "establish principles and criteria for the elaboration and implementation of national policies for responsible conservation of fisheries resources and fisheries management and development" (article 2) | |
| (a) Inadequate management units | By their nature, international fisheries instruments have tended to focus on the relationship between States, e.g. UNFSA. However, the CCRF gives more explicit recognition to the economic and management role of small-scale fisheries, particularly artisanal and subsistence fisheries (article 6.18) and the need to develop institutional and legal frameworks taking into account coastal communities and customary fishing practices (article 10). | CCRF, article 6.18, article 10. |
| (b) Conflicting objectives between managers and fishers | Not addressed. | |
| (c) Preference for coastal State fishers | Addressed in part by UNFSA which seeks to restore a balance between the sovereign rights of coastal States in the EEZ, freedom to fish on the high seas and the broader community interest in conservation and management throughout the range of stocks. | UNFSA, article 3, 4, 5 and 6. |
| (d) Correct identification of policy issues | Expressed in the context of integrated coastal area management: CCRF (article 6.8 and article 10) set out policy and institutional framework to ensure sustainable and integrated use of resources. | CCRF article 6.8, article 10 |
| **Institutional factors** | | |
| (a) Weakness of regional fishery bodies | Major achievement of UNFSA is to substantially reinforce the role of regional fishery bodies as the appropriate framework through which coastal States and fishing States can cooperate to establish management regimes and agree on problems of allocation and effort limitation. | UNFSA, article 10. |
| (b) Poor choice of management instruments | Existing instruments give adequate management choices, problem lies in implementation. UNFSA provides guidance for mandates of regional fishery bodies (article 10), particular problem is ineffective decision-making. IPOA-Capacity provides guidance on appropriate mechanisms for controlling input/output. | UNFSA, article 10; IPOA-Capacity |

Some useful, albeit extremely preliminary, conclusions may be drawn from the above brief analysis.

- Considerable progress at the international level has been made in creating mechanisms for addressing the problems of IUU fishing, especially through the IPOA-IUU Fishing and relevant provisions of UNFSA;

- Some progress has been made in addressing biological and ecological issues, especially through the emphasis in both UNFSA and the CCRF on the application of the precautionary approach and a growing recognition of the need for ecosystem-based management;

- Less progress has been made in addressing the problems of sustainability in small-scale and artisanal fisheries, with the focus at international level mainly on the role of States and national fisheries administrations.

- Progress has also been made in addressing institutional issues, and in particular in defining more clearly the functions and responsibilities of regional fishery management bodies.

It is important to stress that the problem with ocean governance generally today is not that there is no legal framework but rather how States should act in the discharge of their responsibilities under the Convention and related instruments and in the exercise of the rights and duties ascribed to them. The major problem today is not so much with respect to the legal framework at the international level but effective discharge of duties or responsibilities for ocean governance in areas under national jurisdiction for which international law has provided States with extensive competence. Unfortunately, a review of the activities of States will reveal that a majority of them have assumed jurisdiction of maritime zones but have not developed national policies to administer these zones in a manner consistent with the sustainable use of the oceans and their resources as envisaged by the Convention. As is confirmed by the FAO study, marine resources development cannot be viewed independently of the overall socio-economic development. The dimension added by the marine sector must therefore be viewed in the overall context of national development priorities. Governments need to better integrate their policies on marine development in their overall development strategies so as to ensure an appropriate allocation of resources between the marine and other sectors. It is important, therefore, that any administrative structure or mechanism for ocean management should ensure adequate coordination at the national level. Such a structure should allow for the initiation and implementation of national ocean development objectives while at the same time facilitating the discharge of obligations relating to regional and global ocean management, especially those reflected in the Convention. Such coordination at the national level will also ensure more effective collaboration bilaterally and multilaterally with the various international and regional organizations and agencies that have been given a role to play in the system of global ocean governance.

## D. Regional fishery bodies

One of the most significant and important trends in recent years has been the emphasis on the role of regional fishery bodies in promoting sustainable management of fisheries, especially shared fish stocks and straddling and highly migratory fish stocks. Indeed, in the case of the latter categories, the UNFSA, supported by the provisions of the CCRF establishes the regional fishery body as the paradigm for conservation and management of fisheries

resources. Thus, the regional fishery body is established as the primary mechanism through which States should fulfil their obligation to cooperate under the 1982 Convention. Articles 9 and 10 of the UNFSA (which are echoed in the CCRF) set out the functions of regional fishery bodies. Article 10 provides that:

> "[I]n fulfilling their obligation to cooperate through subregional or regional fisheries management organizations or arrangements, States shall:
>
> (a) agree on and comply with conservation and management measures to ensure the long-term sustainability of straddling fish stocks and highly migratory fish stocks;
>
> (b) agree, as appropriate, on participatory rights such as allocations of allowable catch or levels of fishing effort;
>
> (c) adopt and apply any generally recommended international minimum standards for the responsible conduct of fishing operations;
>
> (d) obtain and evaluate scientific advice, review the status of the stocks and assess the impact of fishing on non-target and associated or dependent species;
>
> (e) agree on standards for collection, reporting, verification and exchange of data on fisheries for the stocks;
>
> (f) compile and disseminate accurate and complete statistical data, as described in Annex I, to ensure that the best scientific evidence is available, while maintaining confidentiality where appropriate;
>
> (g) promote and conduct scientific assessments of the stocks and relevant research and disseminate the results thereof;
>
> (h) establish appropriate cooperative mechanisms for effective monitoring, control, surveillance and enforcement;
>
> (i) agree on means by which the fishing interests of new members of the organization or new participants in the arrangement will be accommodated;
>
> (j) agree on decision-making procedures which facilitate the adoption of conservation and management measures in a timely and effective manner;
>
> (k) promote the peaceful settlement of disputes in accordance with Part VIII;
>
> (l) ensure the full cooperation of their relevant national agencies and industries in implementing the recommendations and decisions of the organization or arrangement; and
>
> (m) give due publicity to the conservation and management measures established by the organization or arrangement.

It is noteworthy that the list in article 10 touches upon and correctly identifies several of the factors identified in the FAO study, such as biological and ecological factors (article 10 (d), (e), (f) and (g), as well as economic and social factors (article 10 (a), (b) and (i)).

The mandates of most of the regional fishery bodies in existence today were established before the international fishery instruments referred to in this paper. Unfortunately, it is also apparent that many of these regional fishery bodies have failed to achieve real progress in addressing issues of sustainability. In particular, the functions of many of them do not adequately reflect the requirements of article 10 of UNFSA. One of the most important of these is article 10 (j), which requires regional fishery bodies to agree on decision-making procedures which facilitate the adoption of conservation and management measures in a timely and effective manner. One of the key factors which has paralyzed decision-making in most regional fishery bodies to date is insistence on decision-making mechanisms which either require full consensus of the parties or allow some kind of opting-out mechanism or

objection procedure. If conservation and management measures are not to be undermined, it is important that effective decision-making procedures are adopted.

Annex 2 to the present report examines a selection of regional fishery bodies and attempts to classify them according to a range of management functions and capabilities, which correspond very broadly to the range of management scenarios identified in the FAO study (i.e. no management to market-based management). Although a precise correlation is impossible, and unnecessary for the scope of the present document, an attempt has been made to classify regional fishery bodies according to whether they carry out the following broad functions:

(a) carry out, or promote, scientific research and exchange data between participants;

(b) harmonize national policies relating to fisheries;

(c) establish a TAC for a stock or portion of a stock and allocate quotas between participants;

(d) recommend technical conservation and management measures (of a non-binding nature) for stocks under the purview of the regional fishery body;

(e) adopt binding conservation and management measures which the regional fishery body (through its members) has the power to enforce.

It is apparent from even a very cursory analysis that while most regional fishery bodies carry out functions (a), (b) and (c), which may be described as limited management functions, very few of the bodies in existence today have the mandate or capacity to carry out function (d) and (e).

Work within FAO on review of regional fishery bodies is ongoing. However, the outcome of even this preliminary review suggests strongly that more work should be done to examine whether each of the regional fisheries bodies in existence today has as its primary objective sustainable fisheries, as determined through an analysis of its characteristics, and whether its mandate and functions are such as to promote sustainability.

## CONCLUSIONS

International fishery instruments developed since the early 1990s address directly or indirectly many of the factors contributing to unsustainability in fisheries today. Indeed the instruments considered in this paper reveal a high level of consensus at the international level on the factors to be addressed. It is suggested that the key international fishery instruments would benefit from a more detailed examination and assessment against a more precisely-defined and internationally agreed list of factors contributing to unsustainability. In the meantime, however, it is suggested that the main problem is not a lack of internationally-agreed measures to address problems of unsustainability, but a problem of failure to implement existing instruments.

Some factors cannot be addressed by international instruments, which generally require States to take action, but instead require coordinated action to be taken at national or regional level. The focus of many of the international fishery instruments is on action at the regional level,

primarily through regional fishery bodies. At the same time, however, cursory analysis reveals that many of the existing regional fishery bodies are ineffective and have not successfully addressed key factors affecting sustainability including those relating to compliance, illegal, unregulated and unreported fishing, as well as effective decision-making. Further work needs to be done (which may be done effectively through FAO) to strengthen regional fishery bodies to ensure that these bodies (a) meet the standards established by the relevant international fishery instruments, and (b) possess the necessary mandates to enable them to address the factors affecting sustainability.

In summary, the recommendations for further action proposed in this paper are as follows:

(a) a detailed analysis and assessment should be made of key international fishery instruments against a more precisely-defined and internationally agreed list of factors contributing to unsustainability (e.g. based on the outcomes of this workshop);

(b) in the light of such an analysis, a further study should be carried out and recommendations made to strengthen existing regional fishery bodies to ensure that such bodies:

(i) meet the standards established for them by relevant international fishery instruments, and

(ii) possess the necessary mandates to enable them to address the factors affecting sustainability.

# Annex 1: Status of international fisheries instruments

| | *Status* |
|---|---|
| **A. Treaties** | |
| United Nations Convention on the Law of the Sea | Entry into force 16 November 1994. 137 States Parties as at 30 August 2001. |
| United Nations Agreement for the implementation of the provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks | Entry into force 11 December 2001. 30 States Parties as at 30 January 2002: Australia, Bahamas, Barbados, Brazil, Canada, Cook Islands, Costa Rica, Fiji, Iceland, Iran, Maldives, Malta, Mauritius, Micronesia, Monaco, Namibia, Nauru, New Zealand, Norway, Papua New Guinea, Russian Federation, Saint Lucia, Samoa, Senegal, Seychelles, Solomon Islands, Sri Lanka, Tonga, United States of America, Uruguay. |
| Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas | Adopted November 1993 by the FAO Conference (resolution 15/93) and forms an integral part of the Code of Conduct. Not yet in force. Signatories as at 30 August 2001: [22] Argentina, Barbados, Benin, Canada, Cyprus, Egypt, European Community, Georgia, Japan, Madagascar, Mexico, Morocco, Myanmar, Namibia, Norway, Peru, St. Kitts & Nevis, Seychelles, Sweden, Tanzania, United States of America, Uruguay. [Will enter into force on date of receipt of twenty-fifth instrument of acceptance]. |
| **B. Non-binding instruments** | |
| UN General Assembly resolutions | A/RES/44/225 (large-scale pelagic drift-net fishing), A/RES/49/118 (fisheries by-catch and discards and their impact on the sustainable use of the world's living marine resources), A/RES/49/116 (unauthorized fishing in zones of national jurisdiction and its impact on the living marine resources of the world's oceans and seas) [and subsequently see A/RES/50/25, A/RES/51/36, A/RES/52/29, A/RES/53/33 and A/RES/55/8]. |
| Code of Conduct for Responsible Fisheries | Adopted 31 October 1995 by the FAO Conference. |
| IPOA-Fishing Capacity | Adopted February 1999 by the 23rd Session of the Committee on Fisheries and endorsed June 1999 by FAO Council. |
| IPOA-IUU Fishing | Adopted 2 March 2001 by the 24th Session of the Committee on Fisheries and endorsed 23 June 2001 by the FAO Council. |
| Rome Consensus on World Fisheries | Adopted 15 March 1995 by the FAO Ministerial Conference on Fisheries |
| Rome Declaration on the Implementation of the Code of Conduct for Responsible Fisheries | Adopted 11 March 1999 by the FAO Ministerial Meeting on Fisheries |
| Kyoto Declaration and Plan of Action on the Sustainable Contribution of Fisheries to Food Security | Adopted 9 December 1995 by the International Conference on the Sustainable Contribution of Fisheries to Food Security, Kyoto, Japan. |

# Annex 2: Characteristics of selected regional bodies

| Regional fishery body | Focus | Focus and characteristics: Scientific research, exchange of data | Harmonization of national policies | Recommend conservation and management measures | Establish TAC, allocate quotas | Establish and enforce binding conservation and management measures |
|---|---|---|---|---|---|---|
| **A. FAO Regional Fishery Bodies** | | | | | | |
| Asia-Pacific Fishery Commission (APFIC) | Living aquatic resources, including aquaculture, in Asia-Pacific | • | • | | | |
| General Fisheries Council for the Mediterranean (GFCM) | Stocks in Mediterranean and Aegean Seas | • | | | • | |
| Indian Ocean Fishery Commission (IOFC) | Stocks in the Indian Ocean | • | • | | | |
| Fishery Committee for the Eastern Central Atlantic (CECAF) | Stocks off northern Atlantic coast of Africa and Gulf of Guinea | • | • | | | |
| Western Central Atlantic Fishery Commission (WECAFC) | Stocks in Gulf of Mexico, Caribbean | • | • | | | |
| Indian Ocean Tuna Commission (IOTC) | Tunas and tuna-like species of Indian Ocean | • | • | • | • | |
| **B. Selected Non-FAO Regional Fishery Bodies** | | | | | | |
| Comité régional des pêches du Golfe de Guinée (COREP) | Stocks of States bordering Gulf of Guinea | • | • | | | |
| Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (WCPFC) | Highly migratory fish stocks (primarily tunas) in the Western Central Pacific Ocean | • | • | • | • | • |
| Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) | Antarctic marine living resources (krill, finfish) | • | • | • | • | • |
| Commission for the Conservation of Southern Bluefin Tuna (CCSBT) | Southern Bluefin Tuna | • | • | • | • | |
| Commission sous-régionale des pêches (CSRP) | Stocks within EEZs of Cape Verde, Gambia, Guinea, Guinea-Bissau, Mauritania, Senegal | • | • | | | |
| Inter-American Tropical Tuna Commission (IATTC) | Tunas and tuna-like species of S.E. Pacific | • | • | • | • | |
| International Baltic Sea Fishery Commission (IBSFC) | Major commercial species of Baltic Sea and The Belts | • | • | • | • | |
| International Commission for the Conservation of Atlantic Tunas (ICCAT) | Tuna and tuna-like species of Atlantic Ocean | • | • | • | • | |
| International Council for the Exploration of the Sea (ICES) | North Atlantic | • | | | | |
| International Pacific Halibut Commission (IPHC) | Pacific halibut stocks in the Northern Pacific, Bering Sea and Chuckchi Sea | • | • | • | • | |
| International Whaling Commission (IWC) | Great whales in all oceans | • | | • | | |

# PART III

# NOTES AND COMMENTS SUBMITTED BY PARTICIPANTS

# A NOTE ON UNSUSTAINABLE FISHERIES AND TRENDS IN WORLD FISH CATCHES

by

Rögnvaldur Hannesson

## The meaning of sustainability

As clearly stated in the Discussion Paper I (Cunningham and Maguire, *infra*), fish stocks fluctuate for environmental reasons beyond human control. This makes it somewhat difficult to give meaning to the concept of sustainability. Stock levels and yields will not remain constant from year to year despite a constant rate of exploitation. The popular models which convey this must be regarded as pedagogical devices to aid understanding of fundamental principles and, at the best of times, useful for illuminating long-term issues. Long time fluctuations in ocean climate may, however, invalidate even that.

Hence, sustainability of fish stocks is best understood as avoiding irreversible changes in stock abundance. This is the position taken in the Discussion Paper I where it is also pointed out that irreversible changes may be the result of environmental factors and not human exploitation. Substantial year to year fluctuations are therefore reconcilable with sustainability, and for some stocks a top to bottom transition might take several years.

If world fisheries are on an unsustainable track this should sooner or later show up as falling catches. In a separate note this question is discussed in greater detail, from an overall perspective, for groups of fish stocks, and for selected, individual stocks. The picture that emerges from this is one of stagnation for world fisheries as a whole, but not (or not yet) a clear decline. For groups of stocks a mixed picture emerges; the catches from some stock groups have stagnated or declined while others are still on the rise. For individual stocks the picture is likewise mixed. Catches from some stocks, like the Atlanto-Scandian herring and the Peruvian anchoveta, have collapsed and remained low for long periods, only to bounce back. Some of these fluctuations are related to climatic phenomena (the El Nino), but the collapses were most likely precipitated, or prolonged, by overexploitation.

Some stocks, like the Icelandic and the Arcto-Norwegian cod stocks, seem to be in a long term decline. This is all the more interesting, and alarming, as these stocks have for more than twenty years been controlled by a single coastal state (Iceland) or by a consortium of two states (Norway and the Soviet Union/Russia). For the Icelandic stock in particular this is particularly surprising, as the stock is fully controlled by Iceland, which prides itself of a wealth-maximizing management policy looking to the long-term. For neither one of these stocks did the 200-mile limit reverse a long-term (since the mid-1950s) decline. It is possible, however, that climatic factors and not management failures are behind this decline.

The collapse of the Northern cod of Newfoundland is one of the most widely publicized and spectacular examples of a non-sustainable fishery. The collapse was undoubtedly aided by a management failure. The stock was for a number of years overestimated, and the total catch quota was cut too little and too late. Some experts leave some of the blame on changes in

ocean climate, but without the management failure it is doubtful that the cooling that occurred in the ocean off Newfoundland would have resulted in a total collapse.

The cod stocks at the Faeroe Islands provide a counterexample. These stocks were at an all time low in the early 1990s, and biologists recommended a total moratorium. That advice was not heeded, but the catch quotas were cut. Recently the catches have bounced back to the same level as in the mid-1980s.

**Economic Sustainability**

Fluctuations in fish stock abundance will give rise to similar fluctuations in the economic returns in the fishing industry. This will manifest itself as fluctuations in catches and cost per unit of fish caught. Some fishermen will go broke in bad times but in better times investments will occur. Hence we will see fishing capacity and effort wax and wane, irrespective of whether or not the fishery is managed. In analogy with fish stocks, an economically sustainable industry will be one where the capacity of fishing fleets fluctuates around a long term average.

In an economically sustainable fishery investors will, in the long-term, get sufficient return on their capital to keep the amount of capital at the long-term average (the invested capital might even increase if there is an ongoing substitution of capital for labour). That notwithstanding, companies may go broke in hard times, but they will be replaced in better times or refinanced in the expectation of better times. But it is important to realize that an economically sustainable industry could be far from realizing the maximum economic potential of the fishery. In fact the classical result is that fisheries under open access will stabilize at a level where the return on capital is sufficient but where fish stocks have been depleted way below the level which would give maximum economic yield in any meaningful sense.

I think, therefore, that setting the focus on the unsustainability of fisheries misses most of the important issues in fisheries management. The absence of biological and economic sustainability is likely to be an exception and a worst possible scenario in what is otherwise not a terribly bright picture. But it is perfectly possible to have a fishery which is economically sustainable but where no rents are realized and where capital and labour are wasted on a grand scale. Fortunately, the Discussion Paper deals at length with these issues and does so very well. No purpose is served, however, to confuse the issues of realizing the maximum economic potential of a fishery and economic unsustainability.

**Some further perspectives on economic overexploitation**

Fishing is but one way of satisfying our material needs. That is why we need to see the amount of labour and capital devoted to this activity in relation to what we can otherwise obtain from these resources. The material benefits which we forego by having people invest in and devote their labour to fisheries to a greater extent than needed is the reason why there is something wrong with an overcapitalized but economically sustainable fishery. This raises a number of questions, which are dealt with in the Discussion Paper. What about subsistence fisheries where those who fish have no other opportunities? In economic terms the cost of their labour (but hardly of their capital) would be zero. This is the trickiest situation to deal with, I think. But if this is the case, no good purpose can be served by getting less fish than maximum with more effort; the challenge then becomes one of dividing the catch among those who depend on it. The most threatening situation from the point of view of economic

sustainability probably is the one where more and more desperately poor people compete for eking out a subsistence from a limited resource and destroy their own livelihood in the process. This could happen as a result of a "costless" technology where the usual protection for fish stocks provided by a necessary minimum catch per unit of effort is absent. But are there examples of this? Is it likely to happen?

To break the vicious circle of poverty by which people are trapped in the fishery there must be other employment or entrepreneurial opportunities. The Discussion Paper contains many interesting thoughts on how, e.g., rents in the fishery could be used for creating such opportunities. But is it necessary that such opportunities exist before we try to rationalize an overcapitalized fishery? Do we not need both push and pull factors? Often people do not seek out alternative opportunities until they are forced to do so. One may envisage a scenario by which limited entry, individual transferable quotas, or whatever that bars new entrants from the fishery and provides incentives for some to leave leads to a development of new employment opportunities by directing entrepreneurs elsewhere. There is ample reason not to underestimate the entrepreneurship and employability of fishermen who otherwise one might be tempted to write off as human capital with stranded skills. In the exercise of their trade, fishermen often show themselves both inventive and adaptable. Those skills are quite likely to be portable to other settings.

Finally, a comment on community sustainability. This leaves open the definition of a community. Is it a fishing village, a region, or what? Is it at all desirable, or even meaningful, to preserve narrowly defined communities? Growing economies with rapid technological progress are characterized by structural changes which are necessary for achieving economic growth and to accommodate technological changes. We have seen whole industries disappear as a result of such changes, and in other cases the number of people employed in a particular industry has drastically fallen as a result of new and more efficient methods of production. Is there any reason to expect the fishing industry to be any different? Furthermore, would it make any sense to try to prevent or roll back changes in technology that save labour and make traditional fishing and fish processing methods obsolete? The canning industry has drastically declined, due to better transportation and other methods for preserving food. Large and powerful boats have made it possible for fishermen to live in places which are often far away from where they fish but at the same time destroyed the comparative advantage of locations that are closer to the fishing banks. Does it make any sense to halt or reverse such changes? One must be very careful to distinguish between the vested interests of those who might owe the profitability of their investment or their careers to the continued existence of such places and rural romanticism praising the innate value of what often are unattractive and exposed areas.

## TRENDS IN WORLD FISH CATCHES

### The overall development in world fisheries

Figure 1 shows the world catches from capture fisheries 1950 – 1999 (until 1970 there are no separate data on aquaculture, but aquaculture was rather unimportant prior to 1970, as Figure 1 shows). Up to 1970 the total production of fish grew at a rather steady rate of about six percent per year. In the early 1970s there was an abrupt fall in the catches, associated primarily with a collapse of the anchovy fishery in Peru. From 1970 to the mid-1980s the growth in fish catches was much slower than earlier. Then it picked up again, and for about

five years (1983-88) the catches grew at about 4 percent per year, but since the late 1980s the world captures of fish are most appropriately characterized as stagnating. The total has varied between 85 and 95 million tonnes and does not seem likely to exceed 100 million tonnes any time soon.

Despite the stagnation in world capture fisheries the total production of fish has continued to increase. Since 1970 the increase has mainly come from aquaculture. In 1999 the total production of fish was just below 140 million tonnes.

The aggregate picture does not indicate general overexploitation in the sense of falling catches, but stagnation. What picture does emerge if we look at individual groups of fish species? Figure 2 shows the catches of the eight most important groups of fish species, where "importance" relates to total captures in 1999. The "groups" are defined in the FAO database for world fish catches.

*Stagnating or declining catches*

These eight groups of fish species, which together account for two-thirds of the world captures of fish in 1999, fall neatly into two groups. The first group shows stagnation or decline in the total catch but with substantial fluctuations over time. The most important group of fish (in terms of quantity) is *herring, sardines* and *anchovies*. The captures of these fish rose rapidly to exceed 20 million tonnes in the late 1960s and then fell abruptly to about half of that in the early 1970s. The catches started rising again around 1980 and reached a new and higher peak of 25 million tonnes in the late 1980s, then fell, only to rise again in the late 1990s.

The stocks of herring and other small pelagic fish (fish that live close to the surface of the ocean) are notorious for their fluctuations. These fluctuations are caused by natural variations in environmental conditions, which are still poorly understood. The picture that emerges from considering these fish stocks is hardly one of overexploitation but rather full utilization with natural variations. It is possible, however, that the decline in the 1970s was caused by overexploitation. We will return to that point below in our discussion of the Peruvian anchovy and the Atlanto-Scandian herring.

The second most important group of fish, *cods, hakes* and *haddocks*, is also characterized by substantial variations in catches. The total catch may be characterized as stagnating since the 1970s; it reached a preliminary peak in 1976, then dipped and rose to a new and slightly higher peak in 1987 but has since fallen. It gives some cause for concern that for more than ten years the catches of these fish have fallen substantially and almost without interruption. These fish are among the most valuable food fishes and hence the ones where the forces causing overexploitation under inadequate management are likely to be strong.

The catches of *jacks, mullets* and *sauries* rose, albeit with some interruptions, until 1996, but the rise has been much slower than earlier after 1977. The three most recent years of uninterrupted decline are a little too short a time period to make strong statements about overexploitation, but the slow growth since the late 1970s warrants characterizing these stocks as fully utilized.

The last group in this category is *mackerels, snoeks* and *cutlassfishes*. The catches peaked in 1978 and have since stagnated, with substantial year to year fluctuations. This indicates that

the exploitation of these fish has reached its potential but there are few clear signs of overexploitation.

*Increasing catches*

The other four groups are the following: (i) *redfishes, basses* and *congers*; (ii) *tunas, bonitos* and *billfishes*; (iii) *squids, cuttlefishes* and *octopuses*; and (iv) *shrimps* and *prawns*. The catches of all these fish are still increasing, albeit with some year to year variations, and the rate of increase for some of them has not slowed down much over time. Some of these fish are highly priced food fish (shrimp, tuna, bass, squid) for which the incentive for overexploitation in the absence of good management will be strong, Yet we see, at the macro level at any rate, few signs of overexploitation. Judging from the development in catches in the recent past there might even still be some room for further expansion.

Some individual stocks

Even if there are few signs of overexploitation for aggregate groups of fish there could still be overexploitation of individual stocks. In general, one can expect the following development scenario for fisheries: First, the most valuable fish stocks will be exploited. Then, as these stocks become depleted, the fishing fleets are diverted to less valuable stocks. For a time it would be possible to maintain the aggregate level of catches, or even increase it, by exploiting successively less and less valuable stocks, but ultimately this avenue will run into a wall.

To get an idea of whether this might indeed be the case, we shall look at the catches from a few important fish stocks. Which stocks have been selected for this purpose depends on our previous knowledge of different fisheries and the availability of data on different stocks. This is not a global inventory of fish stocks but a selective review which we nevertheless believe sheds an important and interesting light on the question of overexploitation. In addition it illustrates the importance of natural fluctuations.

The Peruvian anchovy

This is one of the most important fish stocks in the world and also the one most notorious for its fluctuations, which are associated with the El Niño phenomenon.

Figure 3 shows the catches of Peruvian anchovy (anchoveta). The catches reached a peak of 13 million tonnes in 1970 but fell abruptly in 1972 and remained below two million tonnes from 1977 to 1985. The catches recovered again in the late 1990s and reached their previous peak, fell again abruptly in 1998 (El Niño again), but recovered quickly. It is possible that the long trough of the 1970s and early 1980s was caused by bad management, but the fishery did ultimately recover, and the recovery was rapid after the latest El Niño disaster.

The Atlanto-Scandian herring

The Atlanto-Scandian herring, alias Norwegian spring-spawning herring, is another stock notorious for its variability. Explaining this variability has long been a challenge for fisheries biologists and oceanographers. Figure 4 shows the development of catches from this stock since 1950. The catch fell abruptly in the late 1960s and did not recover on a significant scale until very recently (after 1990). The abrupt fall in the catch was associated with a steep decline in the stock, which is generally believed to have been caused by overexploitation. The

figure shows a very steep rise in the catches in the 1960s. This rise was caused by a leap in fishing technology. A device called the "power block" made it possible to haul purse seines mechanically instead of by hand, which in turn made it possible to use much larger boats and seines. Over just a few years the fishing capacity of the fleet was increased many times over and by more than the herring stock could sustain. This was well before the 200-mile economic zone and before any serious joint management of fish stocks was initiated; there was no control whatsoever over fishing capacity, effort, or the total catch.

The Atlanto-Scandian herring is a stock that migrates between the 200-mile zones of a number of countries (Norway, the Faeroe Islands, and Iceland) and is also accessible on the high seas outside 200 miles. Since the late 1990s the countries concerned (Norway, Russia, the Faeroe Islands, Iceland, and the European Union) have managed to agree on limiting the total catch of this fish. This does not automatically imply that they have succeeded in setting the catch at the level which would be appropriate from a long term perspective, but there is reason to believe that the agreed catch limits may not be far above this; the quota agreement for 2001 implied a fishing mortality of 0.14 instead of 0.125 recommended by fisheries biologists.[1]

Pilchard and anchovy

Pilchard and anchovy are two pelagic fish species also notorious for their variability. What is also interesting is that they seem to vary against one another, so that one stock replaces the other over time. Whether these shifts are caused by exploitation or natural forces can be argued over, but it is well known that such shifts have taken place for natural reasons in various places and at various times (sardine and anchovy off California is one example). Figure 5 shows the catches of pilchard and anchovy in three areas; off Japan, Southern Africa, and Chile and Peru. The catches of these species are seen to vary inversely with one another. This points to climatic conditions, such as the El Niño, as the source of these variations and in such a way that the carrying capacity of nature is alternatively utilized by either of these species. To the extent these variations are caused by variations in natural conditions it would clearly be inappropriate to take declining catches as a sign of overexploitation, but an interesting and intriguing question is whether overexploitation of one species rather than natural forces might cause such shifts in stock abundance.

Icelandic cod

The Icelandic cod stock is one of the most important fish stocks in the Northeast Atlantic and one that has been exploited for a long time. Figure 6 shows the catches of Icelandic cod since the early 20$^{th}$ century. The effect of the two world wars is clearly visible; both wars brought a major reduction in fishing pressure due the disappearance of foreign fleets. After both wars the fishery expanded greatly. Since 1955 the trend in the total catch has been downwards, albeit with substantial year to year variations. It is not possible to see any positive long-term effect on the catch of the 200-mile zone; in the year immediately following its establishment in 1975 the total catch increased, and particularly the catches taken by the Icelanders themselves, as they replaced the foreign fleets in the area. This is all the more serious as the Icelanders have total control over the stock and make repeated claims of managing it successfully. To some extent adverse environmental conditions could be to blame; the sea temperature around Iceland has been lower since 1960 than in previous periods.

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[1] "Havets ressurser", *Fisken og havet*, No. 1, 2001. Institute of Marine Research, Bergen.

## The Arcto-Norwegian cod

The Arcto-Norwegian cod is also one of the largest and most important stocks of demersal fish in the world. The stock has been exploited since time immemorial, but the catches which it was possible to wrest from rough seas and in bad weather were severely limited by the primitive technology of the past. For a long time the catches were limited to the feeding and spawning migrations to the Norwegian coast from the Barents Sea and the seas around Spitzbergen. This all changed with the development of deep sea trawlers in the last century.

Figure 7 shows the catches from the stock since World War Two. As for the Icelandic cod, World War Two provided a temporary reduction in fishing pressure. The catches peaked in the mid-1950s, just as for the Icelandic cod, and the trend has been downwards ever since. Also similarly to the Icelandic cod it is not possible to see any positive long-term effect of the 200 mile zone on the catches. Some would argue, however, that the 200-mile zone made it possible to avoid a total collapse of the fishery around 1990. The stock was then at an all time low, and the catches were cut back severely, through a joint effort by Norway and the Soviet Union. The stock recovered and catches increased, but lately the catches have started to decline again.

## The Northern cod of Newfoundland

The bleakest story is told by the fishery for Northern cod off Newfoundland. This used to be one of the richest fisheries in the world, and European nations (the British, the French, and the Spanish) fought over the access to this fishery in the past. Figure 8 shows the catches from this stock from 1850 and until this fishery collapsed in the early 1990s. There was an enormous increase in the catch in the 1960s, due to the development of deep sea factory trawlers, mainly from the Soviet Union and its satellite states in Eastern Europe. This was probably not sustainable, although the collapse of the stock came many years later and well after most of the stock had come under the jurisdiction of Canada (part of the stock was still accessible in the open sea on the so-called nose and tail of the Grand Banks of Newfoundland).

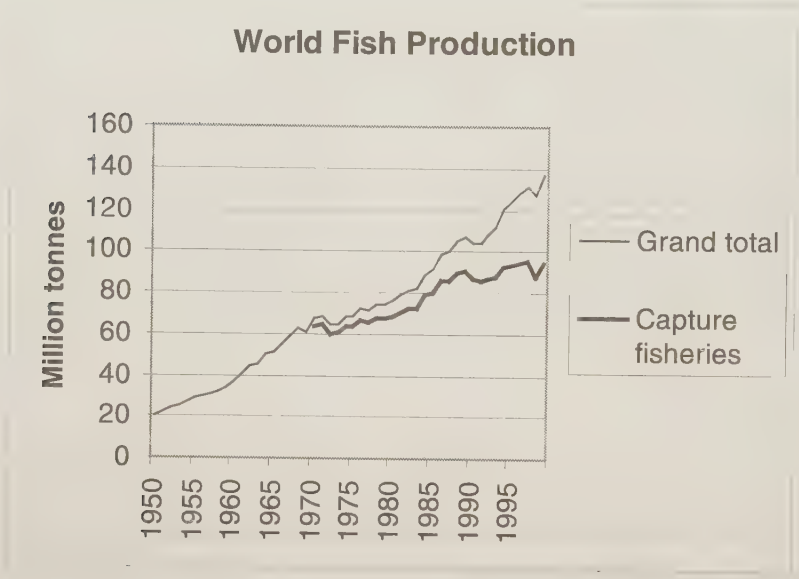
The collapse of the stock has by many fisheries biologists been attributed to faulty management by the Canadian authorities. The biologists responsible for giving advice on the management of the stock did not discover the stock decline early enough, and the Canadian government was slow in cutting back the total permitted quota, because of the adverse effects this would have on job opportunities in Newfoundland. Cooling off of the ocean off Eastern Canada may, however, have been a contributing factor, and some would argue that this was the decisive factor. Increased herds of seals feeding on cod, due to the near halt of the seal hunt, has also been mentioned as a possible reason for the collapse, and for the fact that few signs of recovery have been detected over the nearly ten years that have passed since the fishery was closed down.

## The Faeroe cod

A more optimistic story is told by the cod stocks at the Faeroe Islands (Figure 9). These catches are taken from two apparently separate stocks within Faeroese waters. Both of these were at their all time low in the early 1990s, and fisheries biologists recommended that no catch at all be taken from one of them while the catch should be severely curtailed for the other. The advice was not fully heeded, although the catches were severely reduced. The

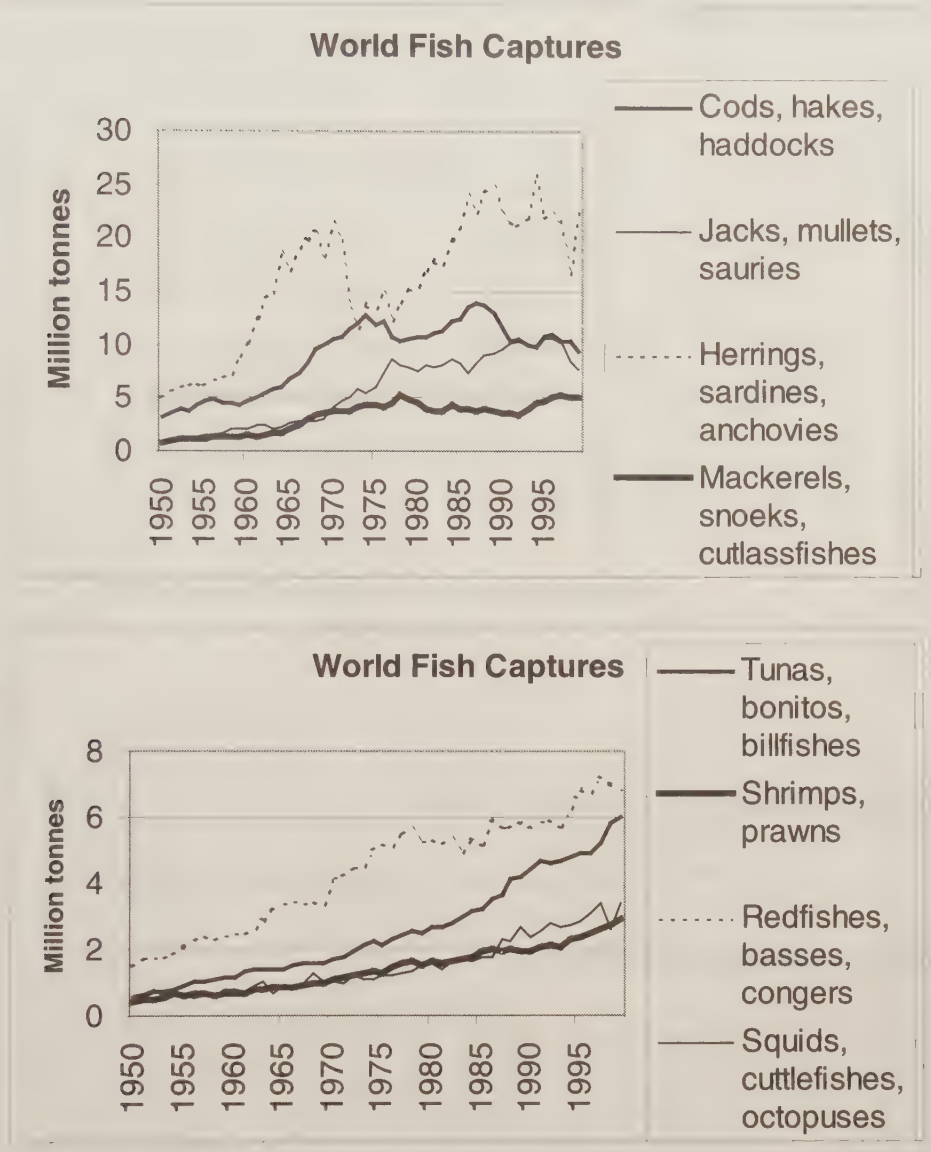
stocks nevertheless recovered, and a few years later the total catch had recovered to a level similar to the mid-1980s. Fortunately the debacle of the Grand Banks was not repeated at the Faeroes.

**Figure 1: World fish production 1950 – 1999**



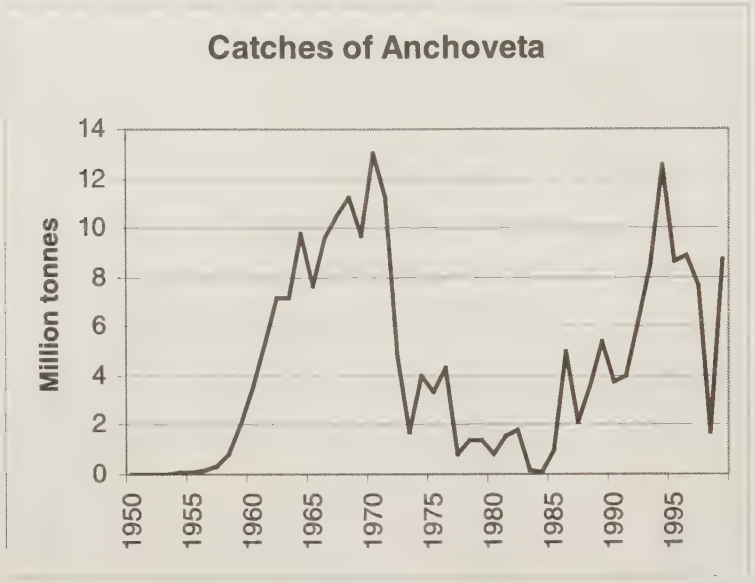

Source: FAO fisheries database

**Figure 2: World production from capture fisheries: eight most important species groups (1950 – 1999)**



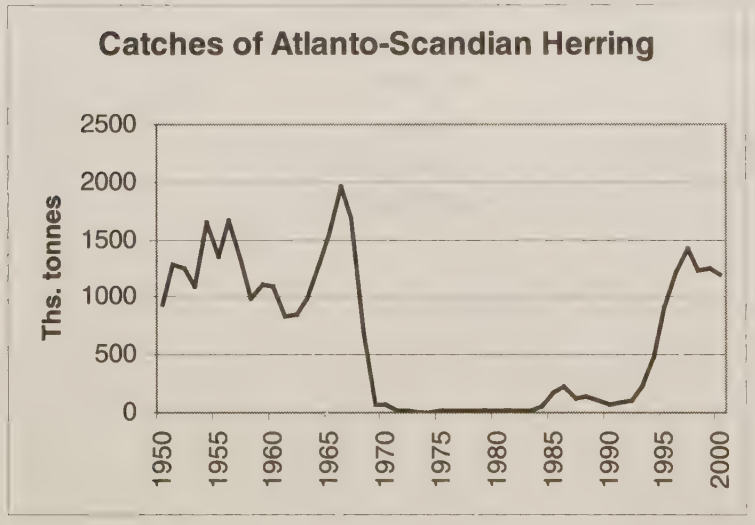

Source: FAO fisheries database

**Figure 3: Catches of Peruvian anchovy (anchoveta) 1950 – 1999**



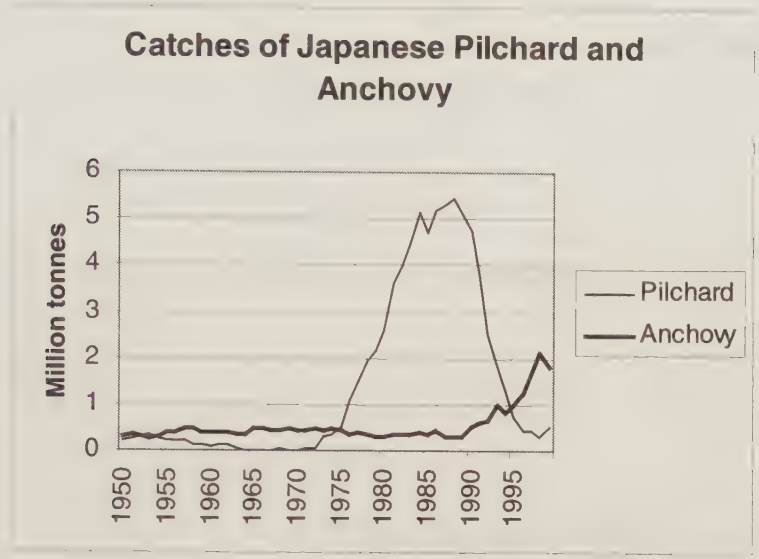

Source: FAO fisheries database.

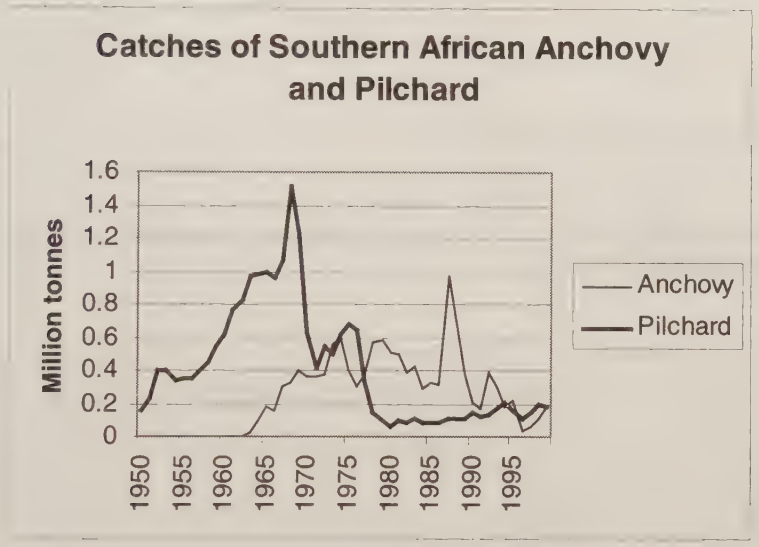
**Figure 4: Catches of Atlanto-Scandian herring 1950 – 2000**

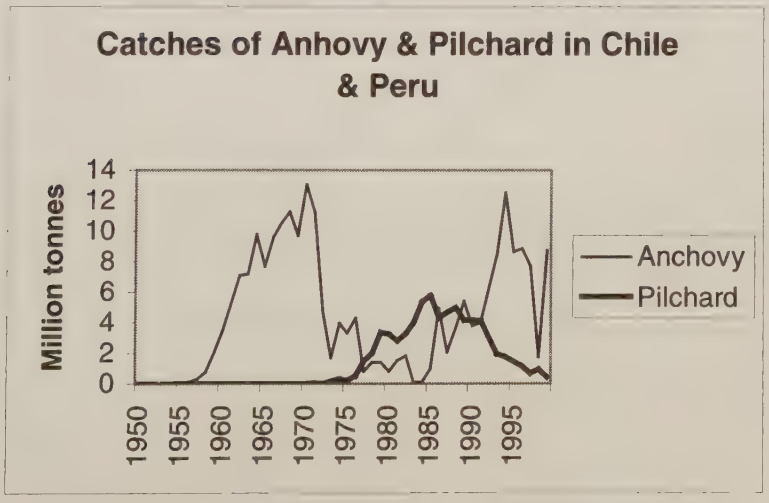



Source: *International Council for the Exploration of the Sea* (ICES), Cooperative Research Report No. 210, Copenhagen 1995, and *Fisken og havet*, No. 1, 2001, Institute of Marine Research, Bergen.

**Figure 5: Catches of pilchard and anchovy in selected areas 1950 – 1999**

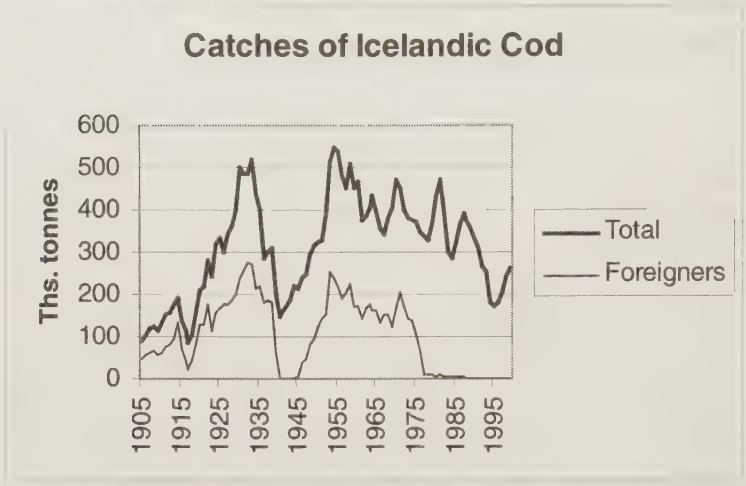


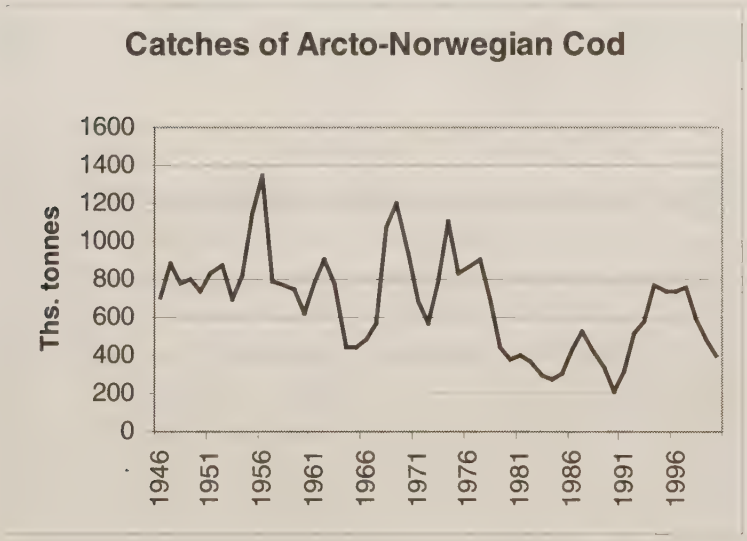

Source: FAO fisheries database

**Figure 6: Catches of Icelandic cod 1905 – 1999**



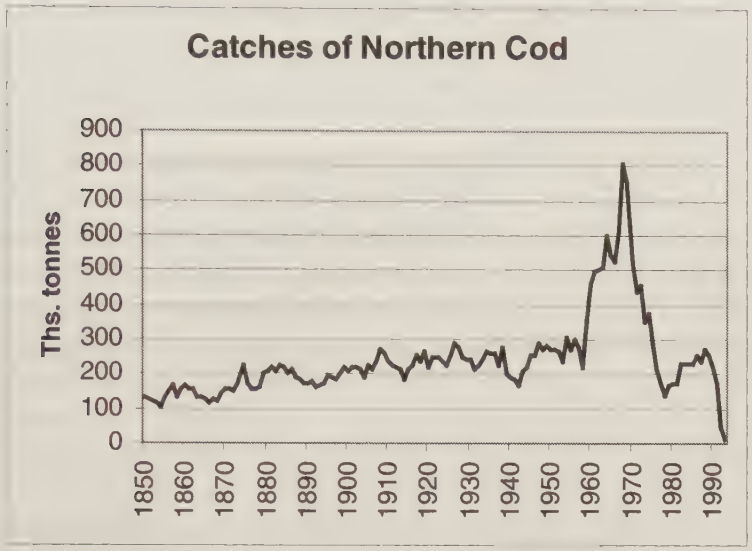

Source: *Útvegur* (Fisheries Statistics). Statistics Iceland, Reykjavik.

**Figure 7: Catches of Arcto-Norwegian cod 1946 – 2000**



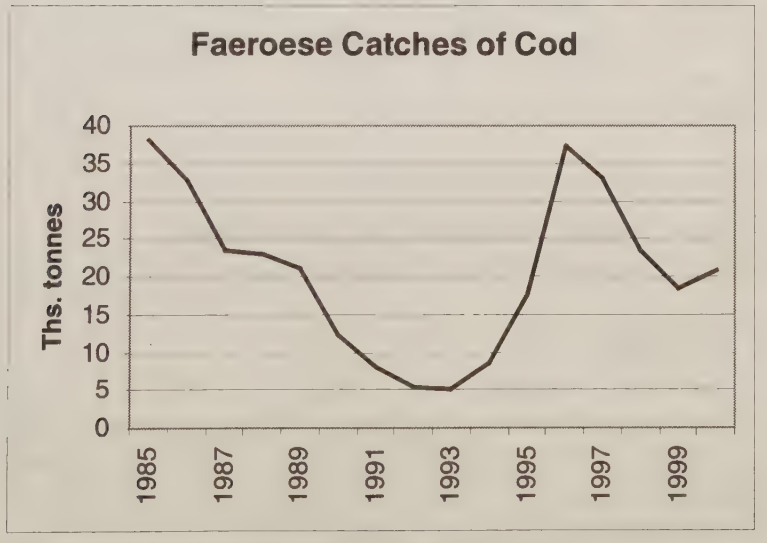

Source: *International Council for the Exploration of the Sea* (ICES), Cooperative Research Report No. 210, Copenhagen 1995, and ICES, Arctic Fisheries Working Group Report 2001.

**Figure 8: Catches of Northern cod of Newfoundland 1850 – 1993**




Source: Dr. Ram Meyers, Canadian Department of Fisheries and Oceans, St. John's, Newfoundland.

**Figure 9: Faeroese catches of cod on Faeroese grounds 1985 – 2000**




Source: ICES, Northwest Working Group Report 2001

# NOTES ON FACTORS OF UNSUSTAINABILITY

by

Serge M. Garcia

## Introduction

Scales

Factors of unsustainability are sensitive to the geographical "units" chosen for the analyses. These units should reflect the geographic scale of ecological processes that reasonably define fishery resources and ecosystems, fishing activity (the pressure), and political jurisdictions (the response). They are also sensitive to the functional unit selected (ecosystem or area, one fishery, the fishery sector, etc.).

Reference frameworks

Factors of unsustainability can be organized from different angles depending on the objective of the organization: according to the Pressure-State-Response framework, the Sustainable development framework of FAO, the ESD framework.

Fisheries will be unsustainable unless all its interdependent components are stable, e.g :

- the ecosystem, e.g. the fishery resources, other aspects of ecosystems that control the productivity of the resource, including dependent and associated species, habitats, climate;
- the economy, e.g. the costs and benefits within the fishery, and monetary flows into and out of the fishery;
- the technology, e.g. the equipment used for capture, processing, distribution; and
- the governance, e.g. set of regulations, mechanisms, organizations, used for policy, planning, management and enforcement.
- The social capital with non-monetary costs and benefits;

Unsustainability in these elements will come from, *inter alia*:

- inexistent or inadequate objectives (or expectations) relative to the component;
- erroneous "model" (either conceptual or numerical) and understanding used as basis for governance;
- ineffective governance.

Unsustainability needs to be defined concretely in terms of relation between the **state,** and/or **rate of change** and **functioning** of elements in the system in relation to **reference values**. The latter are defined by the management mechanism (in terms of objectives), Nature (in terms of constraints) and society (who decides the system of values).

## Unsustainability issues in marine capture fisheries

### The concept of unsustainability

The concept of **unsustainable development** has never formally been defined and must therefore be taken as the antonym of **sustainable development**. To a large extent, looking at the factors of unsustainability is looking at lacking or poor factors of sustainability.

In is not clear, at this stage, whether the factors of unsustainability are exactly symmetrical to the factors of sustainability. Referring to the definitions of sustainable development, unsustainable development could be simply defined as "development that **cannot** meet the needs of the present generation without compromising the ability of future generations to meet their own needs" (derived from WCED, 1987). Unsustainable development, in this sense relates to the **loss of** quality of life and probability to maintain such quality in the future and should not be narrowly limited to economic bust. In FAO definition terms, **factors of unsustainability** include *the non-conservation of the resource base and ill-orientation of technological and institutional change. They lead to degradation of the resource base (including genetic resources) and other changes that are technologically inappropriate , economically non-viable and socially unacceptable, resulting in the non-satisfaction of human needs for present and future generations, (based on FAO Council, 1988).*

While the definition exercise above may not be very heuristic, it points towards using the past work on sustainability indicators to deal with unsustainability just as a compass, made to indicate the North, can be used to go South. As a consequence, the following is largely based on the FAO guidelines for the development of sustainability indicators for fisheries.

### Aspects of unsustainability in fisheries

When looking at the fisheries landscape, the following problems reflect unsustainability:

- Human-induced changes in ecosystems, including changes caused by fishing, jeopardizing the welfare of current and future generations.
- Catching capacity well in excess of needs so that financial and human resources are not being used efficiently.
- The globalization of markets for fish, which has encouraged the diversion of a significant portion of fish production from local and national markets to export markets, raises concerns about how effectively benefits are distributed, relative to the welfare of a large number of people.
- The image of fisheries with the public at large, informed by environmental NGOs, is not very good and is degrading.

Factors fueling the problem include:

- The fact that the fishing industry is a highly adaptive, market-driven and dynamic internationalized sector within the world economy. This quality becomes a problem when its aggressivity cannot be controlled;
- Fishing pressure is still high, possibly rising, owing to a persistent worldwide upward trend in fish consumption, in concert with continuing human population growth (especially in coastal zones).
- Many fishing fleets are highly mobile, and rapid technological innovation has increased their efficiency and limited the capacity of individual governments to exercise control over fishing pressure.

- Associated with this pressure is a variety of problems including substantial changes in ecosystem structure, wastage through discards, impacts on endangered species, loss of critical habitats, increasing conflicts and confrontations over access to fisheries, and subsidies resulting in excessive harvesting and overcapacity.

Factors responsible for the situation include:

- Poor awareness of factors beyond the conventional realm of fisheries management;
- Lack of awareness about the ecosystem in which fisheries operate
- Fuzzy objectives and lack of performance assessment;
- Lack of integration of fisheries management into coastal area management;
- Disregard for the bio-ecological limits of the system;
- Lack of control of land-based activities that degrade the marine environment;
- Poor control of access to co-resources;
- Weak institutions and legal frameworks;
- Low participation by all stakeholders in the fisheries management process;
- Poor information on fisheries and their environment;
- Erroneous scientific assessments;
- Scarce understanding of the socio-economic characteristics of fisheries;
- Weak systems of monitoring control and enforcement;
- Lack of measures to deal with uncertainty and variability;
- Insufficient commitment of governments and communities;
- Excessive catering of the short-term needs of the workforce at the expense of the long term ones;
- Lack of consideration of the broader economic context.

**The unsustainability frameworks**

Scales and dimensions

It may be useful to adopt one or more frameworks to catalog, and relate, the various factors of unsustainability identified. These can be related to scales of dimensions of sustainable development, as shown below.

**Table 1: Hierarchical typology for factors of unsustainability**

| | | Scale (level) | | | |
|---|---|---|---|---|---|
| | | Global | Regional | National | Local |
| **Dimensions** | Economic | | | | |
| | Social | | | | |
| | Ecological | | | | |
| | Institutional/ Governance | | | | |

**Table 2: Examples of development criteria with indication of the state or value leading to unsustainability for each development dimension**

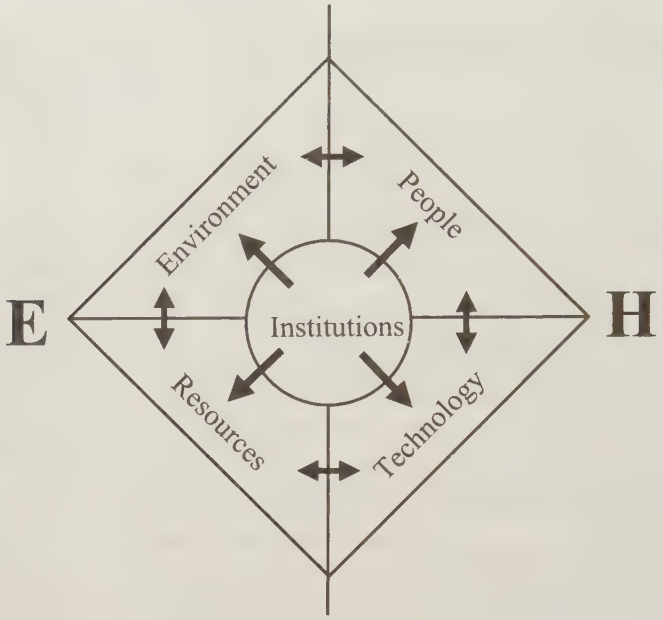
| Dimensions | Criteria | State/ Value |
|---|---|---|
| **Economic** | Harvest | Higher then allowable |
| | Harvest value | High and growing |
| | Fisheries contribution to GDP | High (attractive) |
| | Fisheries exports value (compared with total value of exports) | idem |
| | Investment in fishing fleets and processing facilities | excessive |
| | Taxes and subsidies | not disincentives |
| | Employment | in excess |
| | Income | attractive or too low |
| | Fishery net revenues | idem |
| **Social** | Employment | in excess |
| | Participation | insufficient |
| | Demography | growing |
| | Literacy/ education | low |
| | Protein/ consumption | neutral? |
| | Income | attractive or too low |
| | Fishing traditions / culture | inexistant or degraded |
| | Indebtedness | high |
| | Gender distribution in decision-making | neutral |
| **Ecological** | Catch structure | too selective? |
| | Relative abundance of target species | low |
| | Exploitation rate | too high |
| | Direct effects of fishing gear on non-target species | high, non-reversible |
| | Indirect effects of fishing: trophic structure | damaged |
| | Direct effects of gear on habitats | high, not reversible |
| | Biodiversity (species) | reduced |
| | Change in area and quality of important or critical habitats | negative |
| **Governance** | Compliance regime | poor, ineffective |
| | Property rights | inexistent |
| | Transparency and participation | poor |
| | Capacity to manage | low |

The direction of change of a criteria might be in many cases more important than its level in pointing to unsustainability.

Even after scoping the problem of unsustainability, selecting the appropriate dimensions, criteria, possible indicators and reference values remains a difficulty. Criteria and indicators may be identified for which there is no reliable data. When identifying factors of unsustainability, presumably for corrective action, the following properties should be kept in mind: (1) Policy priorities (i.e. relevance); (2) Data availability; (3) Cost-effectiveness of the corrective measures; (4) Understandability to managers, industry and the public; (5) Robustness to uncertainty; (6) Scientific support; (7) Formal (legal) instruments available.

In the fishery system, and depending on the typology in mind, one would identify: (1) the human and environmental subsystems; (2) the resources; environment, institutions, technology, and people; (3) the Fishing operations;; post-harvest practices; trade; research; management (governance).

**Figure 1: Schematic representation of the FAO sustainability framework**




In reference to the FAO implicit framework for sustainable development (Fig. 1), the sources of unsustainability could originate in:

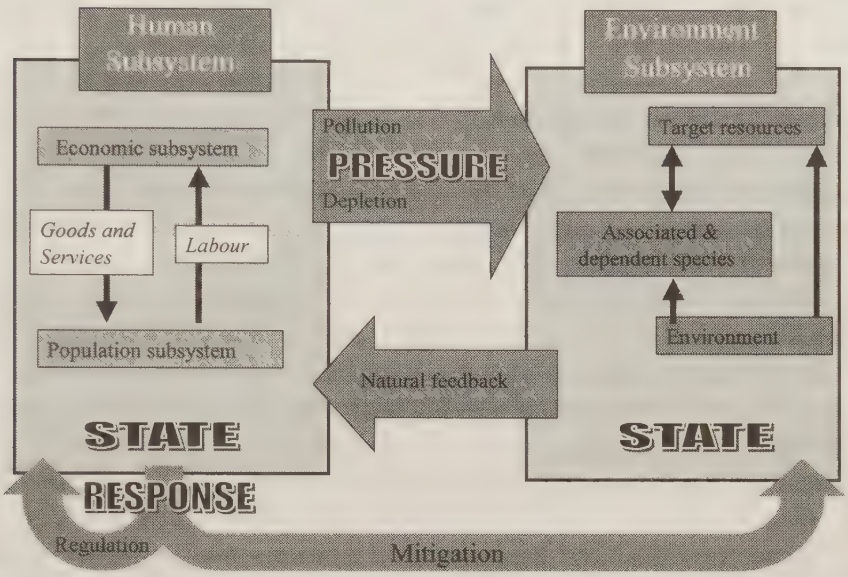
- the environment: e.g. natural variability; degradation; pollution; Climate change;
- the resources: e.g. vulnerability (long life, low fecundity, concentrations, endemism, specific requirements;
- the technology: unselectivity; ghost-fishing; destructive practices; bottom impact;
- the people: population growth; needs (food, employment, livelihoods); rural development; alternative livelihoods;
- the institutions: capacity; resilience; participation; enforcement;

It is also usual to distinguish the techno-economic, socio-cultural; legal-institutional; and bio-ecological factors. Some of them follow:

- technological: unselectivity; ghost-fishing; destructive practices; bottom impact; detection performance;
- economic: low prices (fish harder); high market prices (more incentive); free trade (relate to market prices); low wages (work harder); high wages (attract people);
- social: non-monetary incentives; unrest, wars, equity (new entrants); social cohesion (management traditions; social pressure); lack of awareness; lack of knowledge; lack of participation; non-compliance;
- cultural: perverted food habits (eating juveniles);
- institutional and legal: poor deterrence; poor enforcement; no systems of rights; poor decision-making; non-resolutive conflict-resolution mechanisms; poor participation; lack of transparency (no social feed-back control); inequitable allocation; poor monitoring and lack of transparency;
- biological: poor resilience; long life, high variability; low fecundity; movements (straights); distribution (sharing); behaviour (herding; concentration phases); endemism; special requirements;
- ecological: variability (instability), degradation.

The general framework for sustainable development is less detailed than the Code of Conduct because it has been designed for general application and has the advantage of explicitly identifying the two domains of well-being (the environment and the human subsystems) and how they relate to one another (see Figure 2).

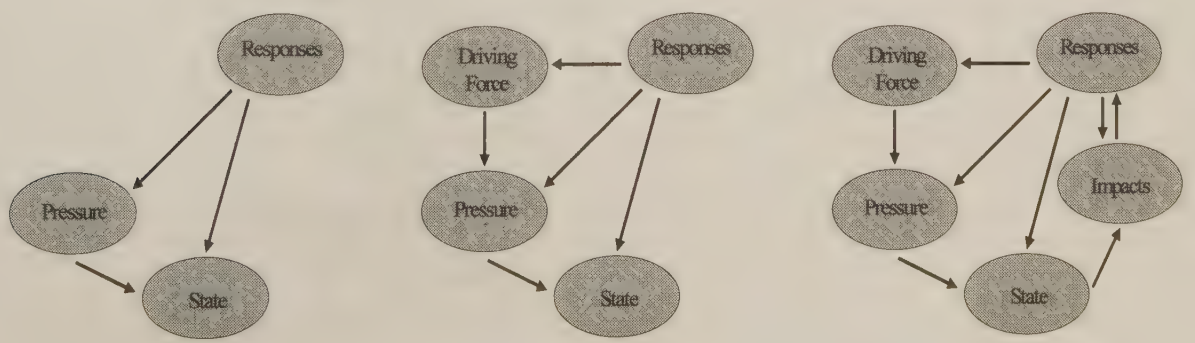
**Figure 2: The general framework for sustainable development**




The system is unsustainable when decisions strongly favour one subsystem at the expense of the other, i.e. when the functional rules and constraints of the life-supporting ecosystem or the vital needs of the people are disregarded. The unsustainability signal comes in terms of social stress and unrest or ecological stress and resource collapses.

The pressure-state-response (PSR) framework (represented in Figure 3), developed by the Organization for Economic Cooperation and Development (OECD) and other international bodies, provides a variation on the general sustainability framework, with its dichotomic representation of sustainability, superimposing on it the state of the two system components as well as the processes that affect these states and in particular the pressure exerted on the environmental subsystem and the responses made by society that affect both subsystems.

**Figure 3. The PSR, DPSR, and DPSIR frameworks**

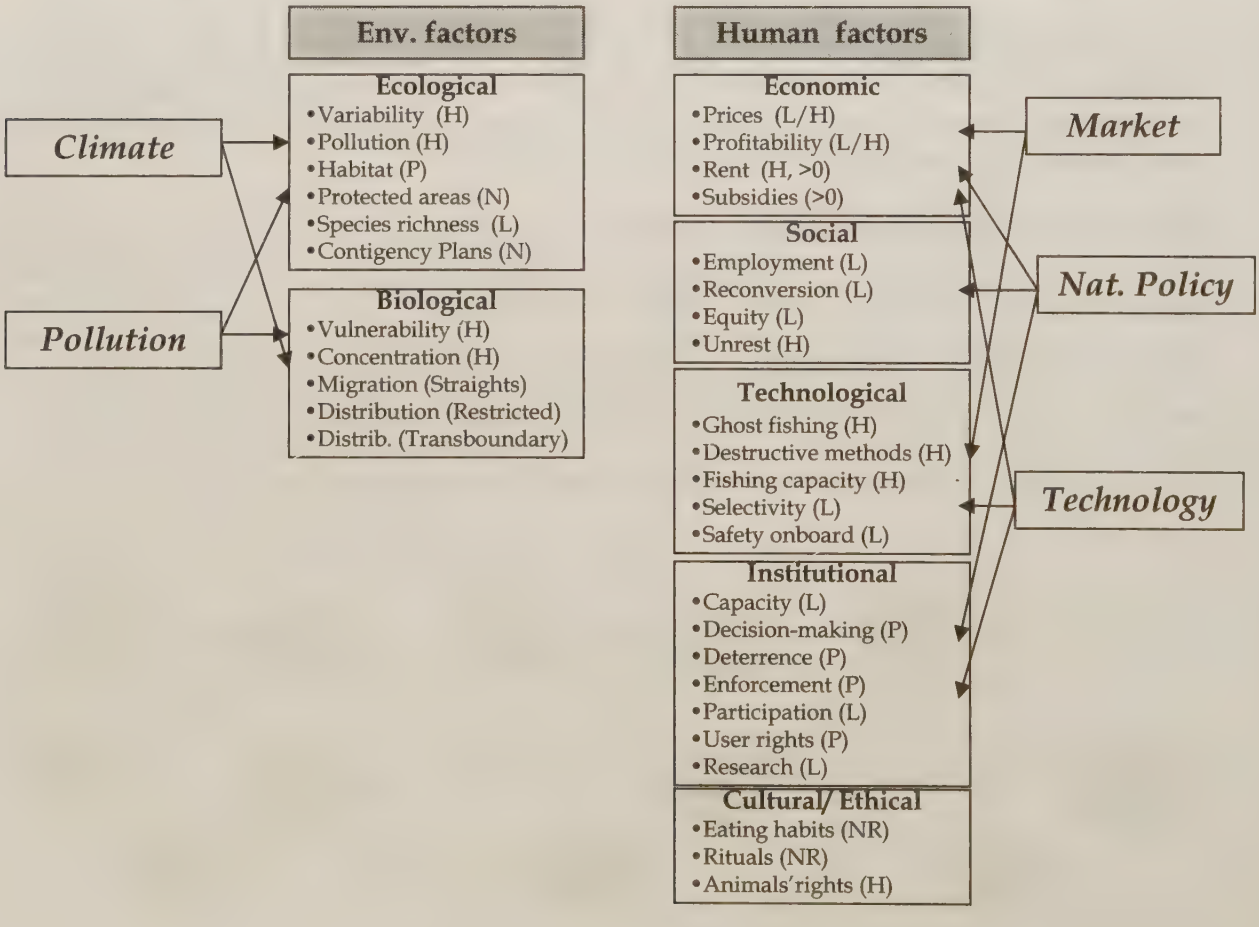


In such a framework, an unsustainable contribution of fisheries to development may come from:

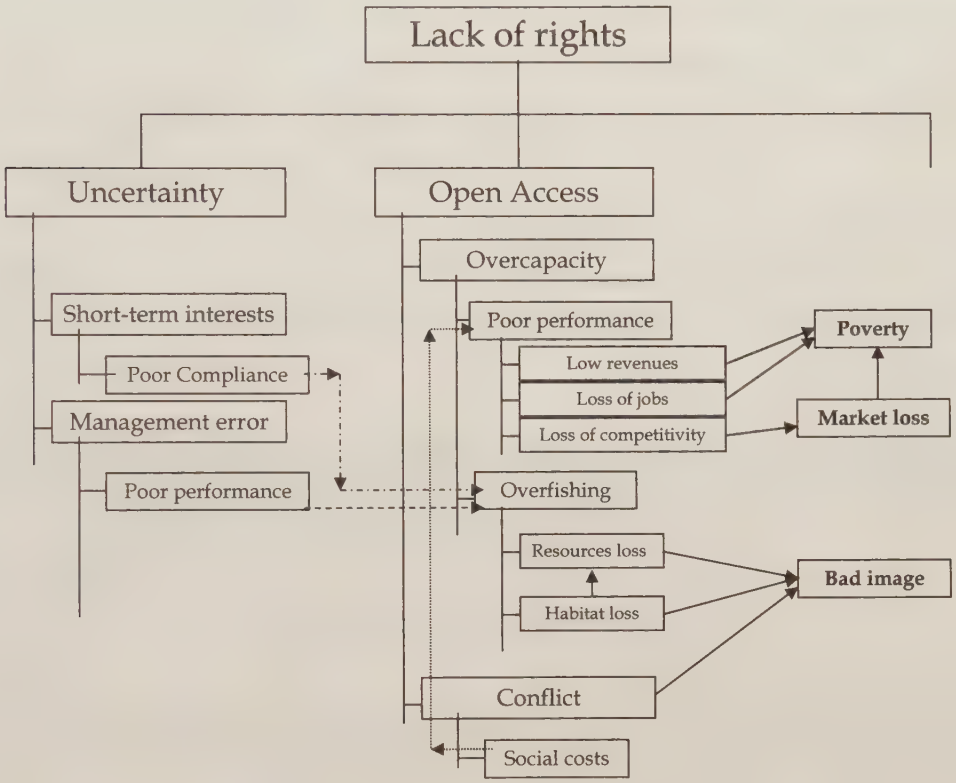
- uncontrolled driving forces
- excessive pressure (accepting that some pressure is necessary to obrain the needed goods and services)
- hidden impacts, not readily "visible", described or felt e.g. when there is a lag time between the pressure and the impact; inadequate monitoring (e.g. forged statistics, inadequate research)
- inadequate responses from governance ("too little too late" decision-making) or stakeholders.

Chesson and Clayton (1998) have proposed a variant of the general sustainable development framework, known in Australia as the ecologically sustainable development (ESD) framework, to assist in determining how well the management requirements for sustainability are met, and how performance progresses over time. The top dichotomic structure is similar to that of the general framework for sustainable development above, reflecting the environmental and human components. The effects of fishing are subdivided into the *effects on humans* and *the effects on the environment* (*sensu lato*, including the *effects on the resource*). The subdivision recognizes that while all effects ultimately influence the quality of human life, some act directly whereas others act indirectly through the environment. The ESD framework establishes, in addition, a hierarchy of elements at progressively higher levels of detail. The framework could be used to list factors of unsustainability (Figure 4).

**Figure 4: Environmental and human factors of non-sustainability and sources influencing them (*in italics*) H = High; L = Low; P = Poor; NR = Non Responsible**



This and other frameworks lead to lists of factors but do not identify the functional relations between them. Developing a "tree" of factors would be more useful for determining priorities for action, understanding relations between causal factors, and eliminating confusion about causes and consequences (see below).



## Annex A: Selected criteria and indicators for ecological, economic, social and institutional/governance dimensions of fisheries

### 1. Ecological criteria

*Wrong catch structure:* too many spawners, juveniles, bearing females,
*Non protection of critical habitats*
*No refuges available*

### 2. Economic criteria:

*Profitability:* if high, attracts environment
*Value of fishing entitlements:* if none, no incentives to conserve or behave responsibly
*Subsidies:* do not lead to performance. Externalization of costs not advisable

### 3. Social criteria

*Employment*: if high unemployment, pressure for open access
*Food security*: overfish if no alternative sources of food
*Tradition and culture*: may be a source of responsibility or not

### 4. Governance/institutional criteria

| Criteria | Institutional factors of non-sustainability |
|---|---|
| *Compliance regime* | Lack of incentives to comply with instruments (at all levels)<br>Existence of outstanding disagreements (lack of consensus)<br>No real enforcement<br>Lack of consensus<br>No explicit relation with recognized frameworks<br>Illegal fishing<br>Flags of convenience<br>Incompatibility between local and higher level enforcement |
| *Property rights* | No well defined and recognized property rights<br>No compatibility of rights with sustainability goals<br>No incentives for cooperative behaviour<br>Lack of equity<br>Lack of consensus |
| *Transparency and participation* | No / poor participation in the elaboration of instruments (at all levels)<br>No incentives for participation in agreements<br>No involvement of major stakeholders in decision and implementation<br>Poor communication between stakeholders and with the public |
| *Capacity to manage* | Lack of human and financial resources<br>Poor statistics and research<br>No management regime<br>No regional body with competence to manage<br>No compliance with legal instruments (at all levels)<br>No matching between development objectives<br>No effective dispute resolution process<br>No precautionary approach<br>No communication / integration between formal and informal governance<br>No decentralization / local capacity |

## Annex B: Example of questionnaires relating to the management system (governance)

| | Factor 1 – Management regime | Response |
|---|---|---|
| 1 | Are management objectives clearly stated, with relative weightings specified? | |
| 2 | Are the rules and regulations of the management system clearly documented and available? | |
| 3 | Has the management system documented a definition of "stakeholders" in the fishery? | |
| 4 | Is the management system sufficiently inclusive of fishing operators as stakeholders to encourage "responsible" resource stewardship? | |
| 5 | Is there a dispute resolution mechanism (e.g. an appeals council) to address issues of procedural & outcome equity? | |
| 6 | Is the fishery subject to outstanding disputes, e.g. over allocation issues? | |
| 7 | Is research to answer ecological questions being supported (e.g. on ecosystem effects of fishing; on sea bed damage; on cetacean by-catch) ? | |
| 8 | Is research to investigate the management and decision-making processes supported? | |
| … | | |
| Additional remarks | | |
| To what extent is the management regime structured so as to ensure precautionary and sustainable management?<br>**OVERALL RATING: GOOD (), ACCEPTABLE (), MARGINAL (), UNACCEPTABLE()** | | |

| | Factor 2 - Decision making | Response |
|---|---|---|
| 1 | Are management decisions, and their rationale, clearly documented and made available? | |
| 2 | Has scientific advice on stock conservation been overridden without overt justification (concerning e.g. social objectives)? | |
| 3 | Are there examples of innovative or experimental management procedures being implemented and monitored (e.g. adaptive management regimes)? | |
| 4 | … | |
| Additional remarks | | |
| To what extent is the decision-making process structured so as to ensure precautionary and sustainable management?<br>**OVERALL RATING: GOOD (), ACCEPTABLE (), MARGINAL (), UNACCEPTABLE()** | | |

| | Factor 4 – Regulation | Response |
|---|---|---|
| | *Do the precautionary management plans specify:* | |
| 1a | Data, including a specification of precision, to be collected & used for stock assessments? | |
| 1b | Decision rules, including risk levels, to be used in determining catch or fishing rate limits? | |
| 2 | Are thresholds defined which trigger pre-agreed action if the stock or the environment approach or enter a critical state? | |
| 3 | Does legislation exist to discourage wasteful practices such as sea dumping of discards? | |
| 4 | Where applicable, are allowable by-catch percentages set? | |
| … | | |
| Additional remarks | | |
| To what extent are regulations implemented which ensure precautionary and sustainable management?<br>**OVERALL RATING: GOOD (), ACCEPTABLE (), MARGINAL (), UNACCEPTABLE()** | | |

| | Factor 5 – Enforcement | Response |
|---|---|---|
| 1 | Is there an identifiable enforcement agency or agencies? | |
| 2 | How many cases were brought against operators in each of the last 5 years? | |
| 3 | Do operators perceive a real risk of cheating being detected? | |
| 4 | … | |
| Additional remarks | | |

To what extent are regulations enforced so as to ensure precautionary and sustainable management?

**OVERALL RATING: GOOD (), ACCEPTABLE (), MARGINAL (), UNACCEPTABLE()**

| | Overall assessment | Rating | Multiplier | Score |
|---|---|---|---|---|
| 1 | Management regime | | | |
| 2 | Decision-making process | | | |
| 3 | Assessment | | | |
| 4 | Regulation | | | |
| 5 | Enforcement | | | |
| | TOTAL | | | |

**OVERALL ASSESSMENT OF RESPONSIBLE AND SUSTAINABLE MANAGEMENT:**

# UNSUSTAINABLE FISHERIES: WHO IS TO BLAME – FISHERS, MANAGERS, SCIENTISTS OR THE ENVIRONMENT?

**(two case studies from Namibia)**

by

David Boyer and Hashali Hamukuaya

## INTRODUCTION

The Namibian fisheries policy is to utilize the living marine resources on a sustainable basis for the benefit of the nation, and to manage them according to scientific information and principles. Ultimate responsibility for control measures rests with the State. A 200 nautical mile Exclusive Economic Zone was declared after independence in 1990, the introduction of a new national policy on exploitation rights and quota allocation in 1991, followed by the promulgation of a new Sea Fisheries Act in 1992. A major emphasis was placed on Namibianization of all sectors of the fishing industry and the establishment of local research and management capacity.

All activities of the major fisheries sectors are catch controlled, by *TAC*s, in conjunction with effort controls, primarily through limited vessel rights. These rights are issued for seven, ten, fourteen or twenty years dependent on a number of criteria. The longer rights are issued to companies who, *inter alia*, are majority owned by Namibians, employ Namibians at sea and on land, have a proven track record in the industry and have demonstrated a long-term commitment by investing in the fishing sector.

Legislation is implemented effectively; all fish must be offloaded under inspection at either Walvis Bay or Lüderitz, and a fisheries observer accompanies all vessels large enough to carry extra personnel. These observers also conduct basic biological sampling. Surveillance is carried out by patrol vessels and aircraft, and a satellite vessel-monitoring system is currently being implemented.

Thus, Namibia, in contrast to many other countries, has many factors favouring successful and sustainable utilisation of its living marine resources. The country has a strong legal framework backed by political will, only two harbours to monitor, friendly neighbours, and a fairly discrete physical system with limited sharing of stocks with other countries. Many international conventions, agreements and codes of conduct have either been signed or ratified giving Namibia the legal (and moral) basis with which to manage its own resources.

Since Independence, the re-building of depleted stocks has been encouraged through strictly enforced management controls, mainly by limited Total Allowable Catches. Several stocks are now showing signs of a sustained recovery, and annual catches have been allowed to increase. Other stocks, notably sardine, remain depleted, while the newly established orange roughy fishery collapsed within 6 years of its initiation.

This paper reviews two cases of unsustainable fisheries in Namibia; the sardine and orange roughy resources[1].

## SARDINE FISHERY

The northern Benguela stock of sardine *Sardinops sagax* used to be considered one of the major clupeoid stocks of the world; it supported an average annual catch of >700 000 tons throughout the 1960s. The stock has been in a depressed state for more than two decades, as demonstrated by annual catches that averaged around 50 000 tons between 1978 and 1989 and only slightly more in the 1990s. It has experienced fluctuations in abundance of several orders of magnitude during the most recent decade. Population size increased until 1992, when the acoustic estimate of biomass was about 750 000 tons. Catches increased accordingly, averaging 100 000 tons between 1992 and 1995, but from 1992 to 1996 the stock was in decline and the lowest annual catch in the history of the fishery was taken in 1996. Although there was a small increase during the last three years of the decade, the stock remains seriously depleted. Survey-based recruitment indices suggest that the changes in the 1990s were initiated by fluctuations in recruitment, but the decline was almost certainly exacerbated by continued fishing. Poor recruitment and decreasing catch rates between 1993 and 1996 in a number of other key resources suggest that system-wide environmental changes were an important factor in the decline of the sardine stock at that time. Anomalous oceanographic conditions, such as extensive hypoxic shelf waters in 1993/94 and a Benguela *Niño* in 1995, support this conclusion.

The following discussion examines the relative importance of fishing and environmental impacts, particularly on recruitment, and why the beginning of a recovery in the stock in the early 1990s was not sustained.

### Effect of fishing

Official records of landings for the decade are a reasonably accurate reflection of total fishing mortality, in stark contrast to the 1960s and 1970s. Dumping of unwanted catch is not permitted and since 1991 has been controlled largely by the practice of placing fisheries observers on most fishing vessels.

During the first half of the decade, the Namibian *TAC* was set almost six months before the start of the fishing season. In 1990 recruitment was not measured, but in 1991, being the first "recruitment" survey, the results were not used for management purposes. For biomass-projection purposes, recruitment was assumed to be average in those years. However, 1991 appears to have been a year of good recruitment, so stock size increased at a faster rate than predicted, and the *TAC* for the subsequent year's fishing season was based on an underestimate of the fishable stock present by the time the season started. This subsequently resulted in fishing mortalities below the target level of 0.2 $year^{-1}$. It can therefore be concluded that fishing levels were moderate until 1992 or 1993 and probably played a relatively minor role in limiting the size of the sardine stock. Indeed, if conditions were favourable for recruitment and growth, it is entirely plausible that fishing mortality could have been higher than the target level without restricting the recovery of the stock.

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[1] The research and management of these two stocks was recently reviewed in two articles (Boyer *et al.* (a) 2001, Boyer *et al.* (b) 2001) published in the South African Journal of Marine Science; A Decade of Namibian Marine Fisheries, Vol. 23, 2001. The following report is selected sections from these papers.

The fishing pressure exerted during 1994 and 1995, given the size of the stock, was excessive. In 1994 the total biomass was estimated at just over 200 000 tons and the *TAC* was 125 000 tons, although only 115 000 tons were landed. This failure to catch the *TAC*, which had only previously occurred in 1976 and 1978, should have sent warning signals to all parties. However, despite a decline in the biomass to around 100 000 tons by 1995, a *TAC* of 45 000 tons was set. Given the small size of the stock, and its rapid decline since 1992, fishing at such a level was likely to be very risky.

In addition, for the first time in more than two decades, vessels were permitted to catch sardine in Angolan waters, starting in late 1994. No limits were placed on the catch, and this increased the harvest to 92 000 tons in 1995, from a stock estimated to be not much larger than this. Following the adverse environmental conditions of the Benguela Niño earlier in the year, this catch proved catastrophic. Apart from about 1 000 tons caught in 1996, and minor amounts harvested by artisanal fishers, no sardine have been caught in Angolan waters since 1995.

Despite the establishment of a TAC of 20 000 tons in 1996, industry was unable to catch sufficient sardine to open any canneries, supporting the survey results and so confirming that the stock had declined to levels rarely seen in any of the other major sardine stocks of the world. Since then, the stock has increased slightly and TACs have followed suit.

**Environmental effects**

1990-1992

There was a relatively cool period at the beginning of the decade until mid 1992, but this early part of the decade is not noted for any particularly adverse environmental features. Stock size was boosted by recruits from the 1989 cohort, and recruitment was above average in 1991 and 1992. During this period, the biomass reached its highest level since prior to the crash of the mid 1970s. Sardine recruitment is generally reported to improve during moderately warm periods (Jacobson and MacCall 1995, Cole and McGlade 1998). However, as outlined in Bakun's (1996) Triad hypothesis and the Optimal Environmental Window hypothesis of Cury and Roy (1989), the factors controlling successful recruitment are complex and, whereas sea surface temperature (SST) is a proxy for some of these, other factors may have assumed greater importance during these years.

1993-1995

Several major environmental anomalies were recorded during this second period. For much of 1993 and 1994, a body of poorly oxygenated water, estimated to be between 50 and 250 m in vertical extent, lay over the Namibian shelf, and levels as low as 0.25 $m\ell\ \ell^{-1}$ were measured between Cape Frio and Walvis Bay (Hamukuaya *et al.* 1998). Although poorly oxygenated bottom waters occur seasonally during periods of reduced upwelling as a result of the decay of organic matter, this event affected a much larger body of water and persisted for longer than usual. Events such as this are thought to be attributable to an influx of water from the Angola Dome (Bubnov 1972). Furthermore, much of the period was characterized by warm surface waters extending over the entire inshore region of the Namibian shelf. This culminated in a Benguela *Niño* in February and March 1995, when a positive temperature anomaly of up to 8°C was recorded in the upper layers, with a deepening of the thermocline

by about 20 m. This unusually warm water mass was found from Cabinda (5°S) to at least 24°S, although above-average temperatures were recorded as far south as Lüderitz (27°S). Benguela *Niños* are thought to be associated with large-scale changes in wind patterns resulting in the poleward movement of warm tropical waters. The southernmost penetration of surface waters was at the beginning of March 1995, after which it retreated with the onset of south-westerly winds (Gammelsrød *et al.* 1998).

These anomalous environmental conditions are likely to have resulted in the poor recruitment of those years. De Decker (1970) reported a reduction in the number of sardine eggs following a low oxygen event off the west coast of South Africa in summer 1967/68. In 1963, a year in which a strong Benguela *Niño* was recorded in the northern Benguela, sardine eggs were virtually absent during the main spawning months (Stander and De Decker 1969). Boyd *et al.* (1985) reported an order of magnitude reduction in sardine egg production, but good survival of larvae, following the 1984 Benguela *Niño*. Therefore, it is perhaps not surprising that recruitment was poor during 1993 and 1995 and that the lowest recruitment index for the decade was estimated by the November 1995 survey. The composition of the 1993-1995 catches confirmed the poor recruitment indices, because they increasingly comprised larger fish.

Despite relatively high numbers of recruits entering the fishable stock in the early 1990s, these cohorts were reduced at rates seemingly greater than could be accounted for by fishing and expected rates of natural mortality (Fossen *et al.* 2001). Whether this apparently high rate of mortality was due to natural factors affecting the survival of sardine or was an artefact of survey bias is at present unclear.

Population declines and large-scale shifts in distribution were recorded in a number of other species during the period 1993-1995, suggesting an increased rate of natural mortality attributable to adverse environmental conditions. The Namibian hake stocks migrated farther offshore (Hamukuaya *et al.* 1998) and their fishable biomass declined by almost half. Monkfish catches fell by more than 25% (Maartens 1999), a significant decline in the horse mackerel stock was recorded and catches of both juvenile and adult components of that stock fell by about 50% (Boyer and Hampton 2001). The Namibian anchovy stock, which had been severely depleted for some years, almost disappeared, and since then catches have averaged around 1% of previous levels. This culminated in dramatic declines of several of the top predator populations, notably those of Cape fur seal *Arctocephalus pusillus pusillus*, which was reduced by about one-third in 1994 and 1995 owing to starvation (MFMR 1997, Roux 1998, Cury *et al.* 2000), and bank cormorant *Phalacrocorax neglectus*, which declined by an even greater amount (Crawford *et al.* 1999). Sardine mortalities were observed once, when a number of dead and dying sardine were found in Baìa dos Tigres during the 1995 Benguela *Niño*, where water temperatures were >27°C throughout the water column. However the numbers of sardine were small in relation to the total stock size. No large-scale die-offs, as reported in Australia at the same time by Schwartzlose *et al.* (1999), were observed.

1996-2000

No marked environmental anomalies were recorded during the latter half of the decade. Sea surface temperatures were close to the long-term average with the exception of early 1997, which was slightly cooler than average.

The 1996 and 1997 cohorts were relatively strong, and the sardine biomass increased from a few thousand tons in 1996 to around 300 000 tons a year later. The fact that this increase in biomass was a result of recruitment was supported by the fact that catches were composed of 96 and 65% fish <22.5 cm in 1997 and 1998 respectively.

The concept of a relationship between spawner biomass and recruitment may be simplistic, especially for a small pelagic species such as sardine, but a minimum threshold biomass has been used by management, suggesting that such an approach has been informative (see Ulltang 1996). It is worth noting that, during the 1990s, there has been a very poor spawner stock-recruitment relationship. Whether this means that the relationship reported by Butterworth (1983), but see also Fossen *et al.* (2001), has broken down or, more likely, that other factors have superseded it, is not known.
The 1998 and 1999 recruitment indices were again below average for the decade, the biomass showed a downward trend, and the average size of the fish caught again increased as catches largely comprised older fish from the relatively strong cohorts of 1996 and 1997. It is interesting to note the change in distribution of the stock during 1997. Instead of the normal inshore distribution of sardine in a water depth of <100 m, most of the stock moved offshore to depths of 200-300 m, and remained there throughout 1997 and 1998. It is not known if recruitment was poor as a direct consequence of this change in distribution, or if it was attributable to the colder than normal conditions.

**Conclusion**

It appears that the processes causing the decline of the sardine stock in the mid 1990s were similar to those of earlier declines; several years of poor recruitment led to reduction in biomass and narrowing of the age structure of the stock (see Fossen *et al.* 2001). Then continued fishing led to an ever-increasing fishing pressure until, in 1996, there were simply so few schools remaining that the fleet was unable to locate any sardine at all. Even the slight increase in 1997 and subsequent increase in fishing levels is remarkably similar to the recovery and increased *TAC*s in the early 1970s.

## ORANGE ROUGHY

Exploration for orange roughy *Hoplostethus atlanticus* in Namibia started in 1994 and, within 12 months, several aggregations had been discovered, suggesting the existence of a biomass sufficient to support a viable fishery. At that early stage it was realized that few, if any, recognized management procedures existed for newly developing fisheries, especially with the paucity of data such as existed on Namibian orange roughy. The first six years of the fishery included a three-year exploration phase, several years of profitable exploitation, and then a severe decline in catch rates. Whether the decline is attributable to fishing mortality or to change in the aggregating behaviour of orange roughy, or both, is not clear. Although many aspects of the precautionary approach were followed, a risk analysis applied and a number of innovative management methods implemented (e.g. incentives to promote exploratory fishing, use of Bayesian statistical methods, implementation of a management plan for long-term total allowable catches), the aggregating biomass declined to between 10 and 50% of virgin levels within the six years.

Francis and Shotton (1997) provide an elegant classification of uncertainty in the assessment and management of fish stocks. These categories are used here to illustrate the Namibian

attempts at managing their orange roughy resource and in particular some of the major types of uncertainty that detracted from its success.

**Process uncertainty**

Process uncertainty accounts for the natural variability in biological processes, and particularly those that control stock productivity. Orange roughy inhabit deep water where environmental conditions are assumed to be relatively constant. Measurements of oxygen, salinity and temperature during four annual research surveys indicate that, at least at the accuracy of measurement, there was little variability. Likewise, commercial vessels report catching orange roughy within a temperature band of 3°C suggesting that, even if there is some variability, the fish try to minimize this by seeking a constant environment. Therefore it is intuitive to expect the biological processes that control the productivity of this stock to have a low degree of stochasticity.

One of the hypotheses tested to account for the large decline in orange roughy biomass on the spawning grounds was that spawning periodicity was either very long or highly variable (McAllister and Kirchner 2001). On purely biological grounds this seems unlikely, but it cannot be disproved. Although little was known about the degree of variability of the key biological processes determining the productivity of orange roughy off Namibia, it seems unlikely that this would have accounted for the observed decline in abundance.

**Observation uncertainty**

Observation uncertainty refers primarily to the ability to collect data on the fishery, stock abundance and biological parameters with reasonable precision and accuracy. Namibia is recognized as having a high degree of control over commercial catches: all orange roughy vessels carry two fisheries observers and all landings are made at a single harbour under the control of fisheries inspectors (Oelofsen 1999, Boyer and Hampton 2001b). Therefore, there was little observation uncertainty in monitoring catches of orange roughy.

The geographic position of orange roughy aggregations, far from any national borders, and the fact that Namibia has a strong monitoring, control and surveillance policy, which not only does not tolerate transgressors, but also has the means to apprehend them, makes observation uncertainty an unlikely candidate for causing the stocks to have declined. Illegal, and hence unrecorded, catches are not suspected to have been a factor.

As little was known about orange roughy at the beginning of the fishery, much research was directed at the resource. Shipboard and port sampling were initiated to monitor changes in population structure, both between grounds and over time within grounds, as well as to track reproductive development. These activities were conducted with the full support of the industry, and generally with their active participation. While there was doubtless some uncertainty in this monitoring process, especially early on, it seems unlikely that this could have accounted for any large errors in the assessment of the stock.

In order to determine the abundance of orange roughy, two types of surveys were conducted in 1997 and have been repeated each year since. As there are many uncertainties in the estimates, it was decided in 1998 that they should be used only to monitor trends rather than absolute abundance. Additionally, the errors of acoustic estimates have been modelled in an

attempt to assess the probability distribution of the estimates (Boyer and Hampton 2001a), so accounting for the most important uncertainties.

However, virtually all research on Namibian orange roughy has been directed at the aggregating component of the stock, through either commercial sampling or surveys. Little is known about the fish outside the aggregations, and the lack of knowledge of this component of the stock may have had severe consequences for the ability to assess abundance accurately. This is discussed in more detail below.

**Model uncertainty**

This form of uncertainty deals primarily with deciding on the best method of representing the stock dynamics of the species in question (McAllister and Kirchner [2001] refer to this as "structural uncertainty"). The conceptual model of the Namibian orange roughy population and community dynamics contained a number of critical assumptions, not least of which concerned stock structure. Initially the stock was considered to be a single unit, but by 1997 it was assumed that each QMA was, for both stock dynamics and management purposes, entirely separate, this being the most precautionary approach. In addition, it was assumed that a constant proportion of the stock migrated annually to the QMAs to spawn. This proportion was unknown, but it was implicitly assumed that most of the stock spawned each year. From these assumptions, it followed that any decline in the stock would be attributable to fishing mortality rather than to changes in behaviour of the stock or stochasticity in the natural behaviour patterns.

Between 1997 and 1999, the swept-area abundance estimates based on commercial data declined between 2- and 8-fold on the various grounds, and the research-based swept-area estimates by 10–55 times. Similarly, the acoustics estimates dropped by an order of magnitude. Four hypotheses were proposed and tested to account for these declines: first, that it was due to the direct impact of fishing; second, that the aggregating behaviour of orange roughy was being disrupted by fishing activities; third, that there was some previously unrecorded stochasticity or periodicity in the spawning frequency of Namibian orange roughy; finally, that there had been a mass emigration or mortality. Modelling suggested, on the basis of the goodness of fit to the data for models based on these hypotheses, that the catch removal hypothesis remained plausible only on Rix. The mass emigration hypothesis remained plausible on all four fishing grounds, and the hypotheses invoking behavioural changes had low credibility on Johnnies and Hotspot but remained credible on the other two grounds. Biologists argued, on the basis of their experience with other fish stocks, that depletion by catch removals was more likely, but they were unable to provide empirical data to support their case. No consensus has yet been reached on whether these hypotheses are biologically feasible.

During the initial stages of the fishery, many biological parameters on Namibian orange roughy were unknown, creating uncertainty in estimating the productivity of the resource. These parameters were for the first two years of assessment assumed to be the same as for New Zealand orange roughy. While this may be intuitively sensible, it did create an additional source of uncertainty. Sensitivity analysis involving testing a range of plausible values showed which were the most critical parameters, e.g. age at maturity, growth and natural mortality. Considerable effort was then expended to determine these parameters using Namibian data, which were used from 2000 onwards. Indeed, the use of a fishing-down strategy to determine optimal fishing levels, rather than taking the less-aggressive approach of

studying the biology and productivity, as recommended by Clark (1995), though seemingly safe at the time, can now be seen to have been a high-risk strategy.

In the Bayesian assessment, priors were included for key parameters such as natural mortality, to account formally for the uncertainty of such parameters in the stock assessment process (McAllister and Kirchner 2001, in press). Also, a Beverton-Holt stock-recruitment relationship was assumed, and recruitment was also allowed to assume some variability, using the same values as in New Zealand.

Another type of model uncertainty was introduced in the initial estimates of abundance using commercial *cpue* data as a proxy for swept-area data. It was assumed that the area of an aggregation was fixed, so mean catch rates were raised by the same area each year to calculate abundance. Kirchner and McAllister (in press) analysed the spatial distribution of the aggregations and concluded that the area was, in fact, not constant, so assuming stationarity greatly inflated the abundance estimates.

In addition, an assumption made during the initial phases of this fishery was that *cpue* tracked abundance, despite strong indications from Clark (1996) that this may not be so for orange roughy. Indeed, some initial indications of declining catch rates in 1996 were discarded as artefacts and the decline was only accepted and incorporated in the stock assessment in 1998. Indeed, the *cpue* data, especially when used in a swept-area type model, were repeatedly used by industry as evidence for the robustness of the stock. As noted above, this type of analysis should have been used with considerably more circumspection for an aggregating species such as orange roughy, especially with the lack of knowledge of the species' aggregating dynamics.

Surveys of orange roughy were conducted using swept-area and acoustic techniques. Once two surveys had been conducted and a time-series existed, these were used as relative indices, recognizing the uncertainty in the estimates attributable to various biases (Boyer and Hampton 2001a). However, a major uncertainty that is still not resolved is whether the surveys, by targeting spawning aggregations, were surveying a constant portion of the total stock each year, or whether this was variable. This again relates to the lack of understanding of the behaviour of orange roughy, and particularly of the aggregations.

It is concluded that the uncertainties introduced through the use of inappropriate model structure or assumptions contributed significantly to an overall failure to predict the decline in orange roughy abundance off Namibia, this form of uncertainty being driven by a lack of knowledge of the biological processes.

**Estimation uncertainty**

Estimation uncertainty is a secondary type of uncertainty derived from some or all of the above three types.

It was recognized from the early days of the fishery that any attempt to estimate optimal catch levels would be fraught with uncertainty, a natural consequence of any new fishery where information is lacking. To compensate for the lack of data, extensive use was made of sophisticated models. Priors on 3–5 key biological and catch parameters and several annual process error terms were introduced through Bayesian statistics, allowing for uncertainty to be incorporated in a rigorous and structured way into the assessment models (McAllister and

Kirchner 2001). Hence, the stock assessment (and risk analysis) was based on best guesses by the available "experts" and elaborate analyses of the limited data available to provide indications of biases and uncertainty in stock biomass estimates. However, some argued that high levels of analysis did not compensate for the limitations of the data being used (as suggested by Ulltang 1996, Rose 1997, Schnute and Richards 2001). Similarly, the priors for catchability were constructed through discussion and agreement by consensus. While this had the advantage of combining accumulated knowledge and experience of many people, it often lacked objectiveness. In hindsight, some of the uncertainties may have been underestimated, possibly by a large amount, especially those that affect the estimation of abundance.

Another unforeseen consequence of achieving consensus was a narrowing of uncertainty. It is suggested that, while this process of constructing priors has its merits, input should be permitted without pressure. Further, all inputs should be used, in other words, there should not be any attempt to reach consensus. Similarly, opposing views (and trends) should not be averaged, because doing so reduces very real uncertainty.

During the initial assessments, the biomass at *MSY* was treated as a target reference point. However, recent literature suggests that this should be a limit reference point (Mace and Gabriel 1999, Serchuck *et al.* 1999). In addition, New Zealand assessments suggested that $B_{MSY}$ for orange roughy was around 0.3 of the virgin stock level (Francis *et al.* 1992) and is derived from a target rate of fishing mortality where catches change with stock fluctuations and are hence maximized. This method requires good estimation of stock size and productivity. However, owing to the uncertainties in this estimate, the more conservative (precautionary) approach of Clark (1995) was followed, i.e. assuming $B_{MSY}$ to be closer to $0.5B_0$, a level derived from a constant catch strategy and hence the more conservative of the two methods. That this level is "precautionary" is highlighted by the fact that the stated management aim in Australia is to rebuild orange roughy stocks to $0.3B_0$ by 2004 (Bax 2000).

It is currently not possible to state whether the estimates of virgin biomass, $B_{MSY}$ and productivity were erroneous or whether there were changes in the behaviour of orange roughy, making the component of the stock assessed in, for instance, 1997 different from that assessed in subsequent years. Certainly the original estimates of abundance using commercial catch data were positively biased, but detailed re-analysis of the early surveys, when the biomass appeared to be high, indicate that the original survey estimates were essentially valid and that the perceived large decline in abundance of fish in the QMAs is real.

Once again it has to be concluded that the major uncertainty in estimating biomasses and productivity emanated from the underlying conceptual model that was assumed for orange roughy, rather than stochasticity in the biological processes or observation uncertainty.

**Implementation uncertainty**

Implementation uncertainty refers to the extent to which management policies and recommendations were implemented. The recommendations made by the Deep Water Fisheries Working Group originally, and later by government scientists, were generally implemented by the authorities with a high degree of faith. In 1997, scientists were more cautious than the DWFWG. Therefore, this form of uncertainty does not seem to have played a major role.

However, there is definitely room for several improvements to the form of management advice. Assessments tended to present results in the form of a mean and a range of probability (90% probability intervals in earlier assessments, but usually 95% in the later ones). In reality, recipients of such information tended to become fixated on the point value (the mean) and to ignore the range. As point estimates are meaningless when *CV*s are large, e.g. >0.3, it may have been more constructive to give ranges only, perhaps using a fairly wide probability interval of, for example, 80%. Additionally, the outputs of some procedures had such wide probability intervals that the results were uninformative and hence of little use for management. Finally, without concrete evidence to validate, or at least support these results, managers (and often scientists too) failed to trust the outputs.

A set of fishing conditions was applied to promote exploratory fishing. However, these were too complicated to monitor and enforce efficiently. As a result, industry tended to "explore" when catch rates on aggregations were low, i.e. out of the spawning period, when the chances of finding new aggregations or defining the limits of known aggregations were reduced. Incentives to encourage exploration were developed in conjunction with industry, but the costs were deemed to outweigh the potential benefits, so exploration was limited. If the proportion of exploratory fishing trawls had been calculated over shorter time periods, e.g. per month or per trip rather than per year, then this strategy may have yielded greater benefits, although it would have been more costly to industry.

Some management protocols were applied, especially in respect of exploratory fishing, but no procedures were developed for setting harvesting levels on the known grounds. This forced annual debate on the state of the stocks and harvesting levels, an extremely costly and time-consuming exercise for all involved.

Notwithstanding the above, it seems reasonable in general to conclude that implementation of scientific recommendations and management procedures had little impact on the subsequent decline in catches. Indeed, *TAC* levels were set even lower than those recommended and so may have extended the life of the fishery. Vessel participation in the fishery was strictly limited to a maximum of five, compared to, for example, the Australian orange roughy fishery in which, in 1999, there were 34 vessels still fishing for orange roughy, down from a maximum of 67 in 1990 (Bax 2000).

**Institutional uncertainty**

Institutional uncertainty is a serious concern in Africa where political, and hence policy, instability is common. Namibia has had a strong, stable government for the past decade with a clear policy towards the utilization of marine resources and, despite some pressure from the fishing industry, has largely abided by it. Owing to the importance of fishing to the Namibian economy, most efforts to protect resources and to increase the long-term output of fisheries gained widespread political, social and economic support. The official policy towards the development of new fishery resources remained unchanged, but some adaptive institutional learning naturally occurred as the orange roughy fishery developed. The establishment of a working group consisting of government managers and scientists and senior industry representatives also reinforced the stability in the assessment and management of the resource.

One restriction in this developing country of Namibia was the lack of local scientific competence. This was solved by contracting international expertise and, although such

expertise was temporary, a progressive training programme was implemented such that, by 2000, most of the survey and assessment work was conducted locally.

## Conclusion

The orange roughy fishery developed and declined in just six years. The establishment of the fishery was planned and controlled in a rational manner. During the initial "discovery" phase, catches were monitored. A research programme was launched to determine and monitor the state of the stocks, while management routines were being established. Monitoring and control was implemented during the second phase, and strategies to promote further exploration and the collection of pertinent data were also introduced. The third phase saw consolidation of all these activities such that, by 2000, much of the research, management and control of the fishery were routine. The scientifically based recommendations were followed with a large degree of faith, and the fishery was, in general, well controlled. Despite this, catches declined unexpectedly fast and, within a couple of years, all stocks were estimated to have been depressed below $B_{MSY}$.

Elaborate attempts were made in the assessments to estimate the abundance of the stocks and to quantify the risks associated with various harvesting levels. One of the greatest difficulties for the assessment was to formulate precautionary advice on *TAC*s in the face of conflicting interpretations of available data and assessment results, and their implications for resource status. The spawning behaviour of orange roughy was, and still remains, poorly understood, and the dynamics of aggregation formation and dispersion are similarly unknown. Therefore, alternative assumptions covering a wide range of biological possibilities were used in the formulation of the qualitative conceptual models of stock dynamics and behaviour, so making interpretation of results difficult.

Biomass was overestimated in the first stock assessment owing to the use of a conventional swept-area estimate of abundance from data on commercial catch rate. The initial survey results, although considerably less than the commercial swept-area estimates, also indicated that the harvesting rates achieved in the early years of the fishery would lead to a gradual fishing-down of the stock towards $B_{MSY}$. Subsequent catch and survey data indicated a dramatic decline in abundance of all stocks, apparently at rates greater than could be accounted for by fishing. Whether this was attributable to overestimating abundance during the early surveys, in which case overfishing could have caused the decline, or to a change in fish behaviour during the spawning period when the stocks were surveyed, remains unknown.

Management usually aims to balance the biological risk of overfishing with the economic loss of underfishing, including taking account of future discounting. However, with a long-lived fish such as orange roughy there is little loss of yield through underfishing. In retrospect, the precautionary approach should have been more rigorously applied, and the limited expansion in effort allowed between 1997 and 1998 should have been avoided until at least two years of research survey data had been obtained, to improve the assessment of abundance. Further time would also have allowed more information on the biology of Namibian orange roughy, in particular on spawning and aggregation dynamics, to be gathered.

The development and decline of the Namibian orange roughy fishery should serve as a warning to other newly discovered fisheries. Even for those with excellent management and fisheries control, full cooperation of industry and high levels of research and population

assessment, catch levels need to be severely limited until sufficient understanding of behaviour and stock dynamics allows stock-specific reference points, such as $B_{MSY}$, to be determined with confidence. Only then should a fishery become a fully operational commercial activity managed to attain optimal sustainable harvesting rates.

The Namibian authorities went to great lengths to guard against such a sequence of events in their orange roughy fishery. Assessment and management created a paradoxical situation whereby state-of-the-art assessment and modelling yielded high quality advice, yet the fishery virtually collapsed within a very short time. There was close cooperation with industry at all stages. A number of strategies for dealing with uncertainty were incorporated into the stock assessment, including a Bayesian approach, and management process, and attempts were made to apply the precautionary approach. In addition, adaptive management was applied through institutional learning. As a result there should be some lessons to be learned from the assessment and management of orange roughy in Namibia. Some aspects provide good examples of how a new developing fishery should be managed; others are clearly illustrative of procedures to be avoided. In particular, one of the main reasons why the management of orange roughy failed to prevent stock collapse was underestimation of some of the uncertainties, particularly those reliant on basic understanding of the biology and behaviour of orange roughy.

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# A SMALL ISLAND DEVELOPING STATES (SIDS) AND SOCIAL SCIENCE PERSPECTIVE

by

Patrick McConney

## Working with words

Sustainability and unsustainability are difficult concepts with numerous dimensions. The focus on unsustainability in this workshop implies to me that we have a fair idea of what sustainability is about and can therefore easily detect the absence of it. I think that we are still grappling with understanding sustainability, and this makes the task of tackling what is unsustainable (or non-sustainable?) even more challenging. Overexploitation in fisheries is easier to define and deal with, but also not a simple task.

It would seem that nothing is sustainable in perpetuity or everywhere, and agreeing on the scale for a particular discourse or action is fundamental for reaching consensus on objectives and measuring progress towards the achievement. These are thorny issues in the negotiation and implementation of international instruments. How scales of sustainability are addressed in the instruments is relevant to the practical approaches or solutions sought in the workshop. For Small Island Developing States (SIDS), and from a social science perspective that is concerned with scales from individual to international, scale is a central issue to be addressed.

## Integrating concepts

Fisheries anthropology and sociology are as old as attempts at conventional science-based management. What is new, and still under-utilized, is the incorporation of this knowledge into conventional fisheries management. Biological and economic knowledge still take precedence. In developing countries and small-scale rural fisheries the manager often knows much more about the fishers than the fish. The focus on understanding *economic* behaviour is also more appropriate to larger scale industrial fisheries than the others. Even in small-scale commercial fisheries the main determinants of fisher behaviour may not be purely economic. Better understanding of fisher behaviour, from their perspective, is required in order to address unsustainability and overexploitation.

Emphasizing human individual, institutional and societal flexibility and adaptation to change, whether humans or other components of nature cause the change, can provide alternatives to rigid or mechanistic perspectives on sustainability. First, humans could be seen as more integral than external to ecosystem models. Ecosystem and human system integration is implicit in holistic treatment of sustainability. Achieving sustainability of fisheries-based livelihoods, for example, may well lead to rational short-term overexploitation of fisheries resources with the expectation of medium to longer-term recovery to sustainable levels. This may not be bad in some specific cases and for certain fishery resources, but it seems much worse if the ecological and human systems are seen as separate, and perhaps conflicting.

The workshop title says "in" and not "of" fisheries. This prompts wider examination of the components that comprise fisheries and the trade-offs that arise between them in the political reality of fisheries management decision-making. Avoiding unsustainability of fisheries

resources, or at least the more charismatic ones, has become much more of an end in itself in recent times than a means to sustain the livelihoods of seafarers. The latter have become more unsustainable. As powerful environmental groups play more active roles in the fisheries arena the emphasis turns from fisheries management and conservation (in terms of sustainable use) to fisheries preservation. This dynamic will increasingly be reflected in international instruments unless the trend changes and some of the instruments that may make fisheries unsustainable due to environmental lobbying for restrictions beyond good management practices will be outside the typical fisheries forums. This may occur in the Convention on International Trade in Endangered Species (CITES), World Trade Organization (WTO), Convention on Biological Diversity (CBD) etc. The relationship between these instruments, and the consultative processes that inform them, versus those concerned more narrowly with fisheries, needs to be considered.

The contribution of overexploitation to the unsustainability of fisheries varies significantly with circumstance. There is seldom a simple cause and effect relationship. Indeed, addressing them both simultaneously is complicated since the intervening, and often more critical, factors must also be clearly explained. There is a need to include wider perspectives such as integrated coastal area management, management for biological diversity, etc. as they impact on fisheries policies and practices. International perspectives highlight the persistent problems of IUU fishing and establishing effective MCS systems that would be less, particularly in the cases of developing countries, if the scales of the issues were national.

The relevance of setting aside both large and small marine spaces as marine protected areas (MPAs) to prevent overexploitation or reduce unsustainability also needs to be addressed. Although my main interest is marine capture fisheries, observations on lake, impoundment, riverine and floodplain fisheries, especially in terms of the external factors that impact on them such as habitat degradation from land-based sources, could be useful issues to discuss for a thorough treatment of the subject. In this context the treatment of transboundary issues that go beyond shared stocks could be considered. It may be relevant to discuss whether the provisions for international, regional and sub-regional cooperation and organizations or arrangements for management have been effective in addressing overexploitation and unsustainability in areas of boundary disputes, spread of pollution, particularly mobile fleets and the like.

**Human and technological dimensions**

An aspect of fishing technology, important to fishers, is that besides focusing on cost reduction and efficiency, some innovations also enhance safety at sea, making the profession or fishery less dangerous and more likely to be passed on through generations. Does this perpetuate overexploitation or invite investment in avoiding unsustainability? The reproduction of labour inputs into fishing, especially through kinship rather than non-kin entrants, is crucial for inter-generational sustainability in some, often small and artisanal, fisheries. It usually contributes to the reduction of unsustainability, especially if the fisheries are also locally or communally managed. In addition, having stable fishing families can contribute to long-term food security in some rural places and lessen the chances of changes that precipitate overexploitation.

Related to this is the level of participation in the fishery, often categorized as full-time, part-time or occasional. In some countries it has been the policy to support primarily full-time fishers and fishing enterprises, but perhaps this has contributed most to overexploitation and

unsustainability. Policies and management measures that promote the flexibility of part-time fishing, particularly in fisheries not critical to mass consumption food security or contribution to the cash economy may be better for reducing the tendency towards unsustainability. Alternative livelihoods need to be given prominence in discussions.

Even more critical in media and market-driven economies is understanding consumer behaviour related to seafood consumption, and perspectives on over-exploitation and unsustainability. This can be linked to matters hotly debated within FAO such as eco-labelling. Uncertainty and other factors may cause well-managed fisheries to become unsustainable from a livelihoods standpoint if the markets for fishery products are constrained by inappropriate trade barriers due to eco-labelling or other similar measures. This may leave the fish populations healthy, but not the fisheries. Some may argue that certain marine mammal populations, for example, are now into an area "over-sustainability" from a utilisation viewpoint.

An additional, and related, concern is that fisheries can become unsustainable if management authorities are forced, or choose unwisely, to adopt management measures the costs of which exceed the benefits, especially in monetary terms. Methods such as Individual Transferable Quotas (ITQs), so favoured by certain countries and promoted as an ideal measure are inappropriate and unaffordable in small-scale, multi-species fisheries and fisheries for small, low-value stocks. The short run excesses may cause fisheries authorities with very limited capacities, such as in most SIDS, to abandon management and so contribute to over-exploitation and unsustainability.

While fisheries instruments, scientific papers and practical prescriptions often acknowledge the special circumstances of developing countries and small island developing states, relatively little is actually done to address the harsh reality of effectively managing fisheries under conventional methods when faced with debt burdens, poverty and other threats to sustainability. Given that the world's major fish stocks, managed mainly by the world's wealthier countries, are fully- or overexploited there needs to be some other mechanism to address assistance to maintaining the remaining stocks beyond what exists now. If the trend to rely on tied bilateral technical assistance continues, as is seen in the declining FAO general budget and tendency for countries with special interests to fund meetings and activities focused on their agendas and interests, then fisheries management in some countries may become more unsustainable.

**Policies and politics**

The contribution of political election cycles, and politics generally, to the unsustainability of taxation measures and perhaps the fisheries generally is often avoided. Taxation tends to have more non-fishery influences than several other measures. Often the macroeconomic climate or structural adjustment remedies dictate fairly closely what is feasible, and taxation could conflict with other general initiatives such as poverty alleviation programmes. In some countries taxation does not have much of an impact on rural, small-scale commercial fisheries. These fishers may not be captured in the tax net, often because of lower limits placed on taxable earnings coupled with informal transactions.

State control, co-management and community-based management as general approaches to governance under which most management measures can be implemented need to be compared. There often persists an impression that State-controlled fisheries management and

science is the ideal. Consequently co-management is really a means intended to serve State ends rather than a process of genuine empowerment intended to make unsustainability less likely through a reconfiguration of interests and the necessary building of capacity amongst the users to manage, or assist meaningfully in management. The attention to co-management and community-based management in discussions on these concepts needs to beware both the extremes of uncritical warm embraces and careless rejection.

Key factors contributing to overexploitation and unsustainability cannot be easily generalized. For example, in large-scale industrial fisheries subsidised inputs causing overcapacity may be a major factor, whereas in small-scale live-food fisheries destructive fishing methods may be used as a short term means to meet livelihood demands perhaps because the responsible alternatives are not clear. Some universal factors may emerge, but attention also needs to be paid to factors in specific relation to particular circumstances. The interaction of factors is complex and needs to emerge from research. It may be best to focus on determining the few most deleterious interactions in an array of common fisheries scenarios.

One of the fundamental priority issues is to agree upon what constitutes, in practice, a truly sustainable or unsustainable fishery given that natural change, both chronic (e.g. climate change) and acute (e.g. cyclone), impacts on the human and non-human parts of the ecosystem. No human action guarantees ecosystem/human system sustainability, but several may accelerate unsustainability. The other priority is to ensure that responsible fisheries are affordable (economically, socio-culturally and politically) everywhere. Alternative livelihoods for fishery resource dependents (not only fishers) and management flexibility that promotes responsible fisheries to reduce intergenerational overexploitation and unsustainability seem most practical solutions. Co-management and community-based management, where feasible, may be the most appropriate approaches, but the management measures used within these approaches will vary.

International fisheries instruments, for example the Code of Conduct for Responsible Fisheries, are recognising the importance of process for identifying common interests and achieving the legitimacy required to facilitate compliance. Unfortunately, this comes at a price. Participation in international negotiations and even national consultations is costly. There seem to be few solutions to the dilemma that those (countries and individuals) who perhaps need most to address issues of unsustainability are those seldom able to become fully involved in the processes. Prudent implementation of existing instruments is more likely to be effective in addressing unsustainability than a proliferation of instruments that complicate the process and pose additional burdens upon participants with limited capacity to meet present or further international obligations. Perhaps, in addition to guidelines, the FAO could present a series of best practices based on the Code of Conduct for Responsible Fisheries.

# A PRESCRIPTION FOR FISHERY PROBLEMS: RACE FOR THE FISH, RISK PRONE DECISIONS AND UNCERTAINTY

by

Michael P. Sissenwine

Before commenting on the causes of unsustainability of fisheries, it is useful to clarify what the term unsustainable means. According to the dictionary, sustainable only requires that a fishery be kept "in existence". From a population dynamics modelling point of view, it can also be shown that a fishery can be sustained indefinitely at a very low level (in terms of yield and fish abundance). Actual experience also confirms that fisheries can be sustained at low levels for long periods of time. Thus, sustainability is not a very demanding standard, as are many fisheries, that scientists, managers, and the fishing industry agree are in trouble, are sustainable. Sustainability is a necessary, but not sufficient, goal for fisheries. I think the goal should be "responsible fisheries" which (1) are sustainable, (2) produce a high level of human benefits, (3) have a "fair" distribution of benefits, and (4) do not cause "unacceptable change" in marine ecosystems (Sissenwine and Mace, In press).

## THE CAUSE OF THE PROBLEM

Many factors lead to fisheries that are overfished, with depleted fish stocks, poor economic performance, and social costs. However, I think that three related factors create a vicious cycle which is the underlying cause of problems for many fisheries worldwide. It is depicted in a diagram (below) from Sissenwine and Rosenberg (1993). The key factors are "the race for the fish" which occurs because of inadequate rights based on allocation of shares of the fishery, uncertain scientific information, and risk-prone decisions in the face of pressure to postpone economic and social hardships. The factors interact. The race for the fish creates incentives for overcapacity, and it undermines long term conservation as an incentive. It also leads to biological overshoots. Once the fishery is in trouble, there is pressure to make risk-prone decisions, and uncertain scientific information makes it difficult for decision makers to withstand the pressure.

The solution to the problem has been articulated many times. It is rights-based allocation, the precautionary approach (which includes risk averse decisions), and more and better scientific information. In fact, applying the first two, without better scientific information will go a long way toward solving the problem for many fisheries (especially for developed regions, compared to developing regions, of the world where there is a lot of valuable scientific information). However, even in these situations, more and better scientific information will make it easier for managers to have the resolve to apply the precautionary approach and it will probably produce an increase in the net value of the fishery.

One form of rights-based allocation is individual transferable quotas (ITQs). This is perhaps the best known method, and it is finding broad acceptance, particularly in developed countries. While ITQs have theoretical advantages over other forms of rights-based allocation, there are other approaches which might have important practical advantages. In developing countries, traditional rights at the community level may be a useful building block for a modern regime of rights-based allocation.

## THE ROLE OF RESPONSIBLE GOVERNANCE

While the three factors and the vicious cycle identified above are well known problems with fisheries, and the ways to address these problems are also well known, implementing solutions has proven to be very difficult. I believe that, ultimately, solutions depend on having in place a responsible governance system. Governance is broader than fisheries management. It also includes self governance of the fishing industry and of the scientific enterprise, and the behaviour of the public and politicians. Sissenwine and Mace (In press) address characteristics of responsible governance.

## OTHER CONSIDERATIONS

There are many other factors that lead to problems with fisheries, such as poor enforcement of fishery management regulations, pollution, etc. One factor that is often highlighted as a cause of problems is subsidies. Undoubtedly, subsidies have led to overcapacity for many fisheries, which fuels the vicious cycle described in the diagram below. However, the problems caused by subsidies are a symptom of inadequate rights-based allocation. Subsidies are a transfer payment. With well defined rights, they make fisheries more profitable for the fishing industry (although they are neutral with respect to rent) but, in general, they should not create much of an incentive for overcapacity or a disincentive toward conservation. They do create market place distortions that are a fair trade consideration.

There are several aspects of international governance of fisheries that are likely to lead to problems, as highlighted in Sissenwine and Mace (In press). They are discussed below.

Rights-based allocation or freedom of the high seas? The need for rights-based allocation applies to all fisheries, yet international law treats fisheries on the high seas as a global commons with access open to all.

The general approach to dealing with the dilemma is to form regional fisheries organizations, and to expect all countries fishing within the region to join. However, once the initial members of the regional fisheries organizations have allocated shares in the fishery amongst themselves, they are often reluctant to give up a "slice of the pie" to new members. Thus, prospective new members can either join with prospects of only getting a small share, if any, or they can continue to fish without joining, claiming that they are exercising their high seas freedom. At least two regional fisheries management organizations are currently trying to cope with this dilemma: the International Commission for Conservation of Atlantic Tunas and the Northwest Atlantic Fisheries Organization.

Clearly, creative solutions are needed. It seems to us that either members of fisheries management organizations must be willing to give up a reasonable share of their allocations, or it will be necessary to change the paradigm of freedom of the high seas.

Dispute resolution: Even if the dilemma above is solved, there is another threat to the effectiveness of regional fisheries management organizations. In most (maybe all) cases, members who dislike management decisions are not bound by them if they "object." This is a form of the "end run." Fortunately, objections are rare, but could become more common as tensions rise with potentially more members competing for a "slice of the pie." We think that responsible fisheries management requires a practical dispute resolution mechanism to pick

the winner and loser in a dispute. Leaving the dispute unresolved usually means the fisheries resource loses.

Management of deep-sea fisheries on the high seas: These fisheries are increasing, particularly on mid-ocean ridges and on seamounts. However, little is know about the fisheries and the ecosystems that contain them, other than that they are almost certainly fragile. We believe that a responsible approach to fisheries management requires that all fishing activity be authorized and that an analysis of the risk of a fishery having an unacceptable impact should be conducted prior to authorization. This is not the case for most of the deep-sea fisheries that are developing on the high seas. Many of these fisheries are not subject to any existing fisheries management authority, except for the general provisions of UNCLOS. In general, they are not straddling or highly migratory fish stocks. We think the international community needs to address this apparent gap in the current international fisheries management system, perhaps by developing an international instrument capable of designating deepwater areas as "marine protected areas."

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# FACTORS LEADING TO UNSUSTAINABILITY IN FISHERIES - FOCUSING ON FISHERIES SYSTEMS AND DRIVING FORCES

by

Poul Degnbol

The objectives of the project are to: 1) identify key factors, 2) identify how they interact, 3) identify priority issues in addressing the problem and 4) consider best practical approaches. The discussion may be best served by proceeding in that sequence.

The background paper takes a matrix approach to unsustainability by discussing driving forces in the context of specific management measures (or management systems as is the term used in the background paper although this term may be misleading, see below). This is a very useful discussion that should be taken in any case.

However, this approach basically combines issue (1), key factors, and (4), practical approaches, on the expense of issue (2), interactions, and (3), issues. The consequence may be that we loose sight of some more fundamental and crucial reasons for unsustainability which are associated with the functioning of the overall fisheries system, i.e. the interactions between key factors and issues. Another consequence when the discussion is structured according to management measures is that we may loose the ability to look at fisheries systems in their specific context.

It is tempting and seems to be a natural thing for scientists and advisors, which have been closely involved with fisheries management and for fisheries managers to structure a discussion on unsustainability factors according to management measures. After all, management measures is what you can play around with as a fisheries manager when trying to alleviate whatever may be going wrong in your fishery. However, this approach deals with remedy tools and single problems rather than the overall properties of the fisheries system leading to unsustainability. The tendency to focus on the management measures in relation to unsustainability is however illuminating: it reflects a realisation that the management measures themselves may be a driving force in unsustainability and the discussion of tools is highly relevant in this context.

One approach to analysing systems properties could be to try to look at conditions for unsustainability as a hierarchy of:

- System properties – properties of the specific context which are decisive for the impact of driving forces and the possibilities to implement specific management tools, the 'sensitivity' of the fisheries system so to say.
- Driving forces for unsustainability – internal incentives and external developments which drives the fisheries towards unsustainability, the pressure the fisheries system is under.
- Management measures, the toolbox available to prevent driving forces from leading to unsustainability.

The point is that the possible impact of driving forces only can be evaluated if the sensitivity of the system to specific forces is known, and that the ability of measures to alleviate the effects of the driving forces only can be discussed on basis of such an evaluation. Or, to put it

the other way round, a general discussion of management measures' ability to prevent unsustainability is of limited value because this ability is so dependent on the specific context in terms of system properties and driving forces. TAC's, distributed as ITQ's or otherwise, may be a marvellous measure to prevent unsustainability in single-country industrialized fisheries with good knowledge and MCS capacity, good information flow and transparency and a governance culture accepting that natural resource exploitation should take place within bounds defined by the community. However, on the coasts of many developing countries and even for international industrialized fisheries along these coasts these conditions do not apply – the most relevant measures to revert from unsustainability may not even be traditional fisheries management measures but may relate to those developments outside the sector which create pressures or (in the case of international fisheries) input measures may be more realistic to implement. Unsustainability factors and contra-measures can only be evaluated in context.

Examples of parameters which could be relevant on these three levels are indicated in Table 1.

The groups are of course interlinked - system properties are in the longer term also a result of driving forces and management measures in the past and misguided management measures may be a driving force for unsustainability. This does however not invalidate the observation that it is necessary to distinguish between context, drivers and responses.

The objectives of the project can be met by:

1) identifying key factors : extend and discuss the driving forces list
2) Their interaction: discuss the driving forces in relation to system properties – that is the basis for their interaction and impact
3) Priority issues: based on the understanding of key factors and how they work in context, it is possible to identify the priority issues, namely the specific combination of a driving force for unsustainability matching conditions (fisheries system properties) which will enable it to have impact
4) Practical approaches: relevant measures to be taken for such combinations of driving force and conditions – whether they are fisheries management measures or extra-sectoral approaches.

Instead of a list of scenarios structured by the management measures axis one may develop a set of fisheries systems scenarios, especially 'vicious circle' scenarios which are combinations of driving forces and system properties which will have a high probability of leading to unsustainability. Such a set could be based on real-life examples, which both can be used as case studies and as a basis for structuring/developing a typology. A list of vicious circle cases could include North Atlantic cod fisheries, foreign fleets off West Africa, emerging deep sea fisheries, coastal fisheries in Vietnam, which each combine a different set of system sensitivity properties and driving forces.

Table 1: Examples of parameters which could be relevant on the three levels of potential unsustainability (for driving forces and management measures parameter are basically taken from the discussion paper by Cunningham and Maguire)

| | | |
|---|---|---|
| System properties | Resource system | Variability |
| | | Resilience |
| | | Closedness |
| | | Scale |
| | Production system | Existing fishing capacity relative to resource base |
| | | Adaptivity |
| | | Technology level |
| | | Scale of operation |
| | | Scale of organisation |
| | Management institution | Balance command-control versus comanagement |
| | | Adaptivity of management |
| | | Embeddedness of institutions – shared knowledge, objectives, legitimacy of institutions |
| | | Knowledge production capacity |
| | | MCS capacity |
| | | Capacity for conflict resolution and distribution decision making |
| | Societal context | The role of fisheries in the larger society (population buffer, food, rent maximisation…) |
| | | Societal wealth – developed/developing |
| | | Distribution/equity |
| | | Governance culture |
| Driving forces | Profitability | Increased demand |
| | | International trade |
| | | Changes in landings |
| | | Decreased input costs |
| | | Resource rent |
| | Access conditions | Open access |
| | | Asymmetric entry/exit |
| | Uncertainty | Knowledge base (process, observation, model) |
| | | Implementation |
| | | Institutional |
| | Improved technology | |
| | Lack of economic alternatives | |
| | Desire for stability | |
| | Subsidies | |
| Management measures | No management | |
| | Technical measures | |
| | Input controls | |
| | Output controls | Overall TAC |
| | | ITQ |
| | | Market based |
| | Combinations of these | |

# SOME THOUGHTS ON MOVING FROM UNSUSTAINABILITY TO SUSTAINABILITY OF TROPICAL MULTI-SPECIE ECO-SYSTEM AND LIVELIHOOD-ORIENTED, SMALL-SCALE, MARINE FISHERIES IN DEVELOPING COUNTRIES

by

John Kurien

*" Some elements of fishing may prove difficult to bring within the management system. If for political or other reasons it is not possible to prevent their increase, then over time they may undermine the system. Obvious examples are recreational fishing in the case of developed country fisheries and small-scale fishers in developing countries."* (Cunningham and Maguire, 2002:21)

This statement, found in the discussion paper prepared for the FAO/UN International Workshop on Factors of Fisheries Unsustainability and Overexploitation, is a good point of departure for the thoughts expressed in this brief note.

Right at the outset we wish to make a counter assertion:

Small-scale fishers and their fishing activities will be central to any long-term vision of fisheries management and development in the developing country, tropical water multi-specie ecosystem scenario. Any future management system for these countries and ecosystems that do not take cognizance of this fact will be ecologically, economically, socially and politically infeasible.

Given the worldwide concern for the depletion of marine fishery resources, there is a growing body of literature and an active concern among policy makers at all levels on what can/should be done to find solutions to moving towards sustainable fisheries. The voyage to unsustainability in both the temperate and the tropical marine waters probably has many common causative factors. However, the *initial conditions and the evolving development process,* that marked these two contexts were different. To that extent, some of the solutions made to the move away from unsustainability to sustainability will also vary.

**Elements in the voyage towards unsustainability in tropical, multi-specie, small-scale fisheries in developing countries**

1. The non-recognition by the state and civil society of (a) the clearly articulated community property rights of fishing communities to the sea and (b) the measures existing vis-à-vis the manner in which individual users of the community could relate to the living resource therein.

2. Following the above, an *ipso facto* conversion of the coastal waters into open access (though *de jure* "state property").

3. The introduction of new "capital-intensive and throughput-efficient" harvesting technologies (e.g. bottom trawls, purse-seines) inappropriate to the tropical water multi-

specie ecosystem. Investments in these artifacts were made largely by investors from outside the fishing communities often with active state support and in the name of "modern fisheries development." Overcapitalisation and ecosystem overfishing results. There were no stock collapses. But fishing down the food-chain has certainly led to the changing composition of the harvest towards an "inferior" mix.

4. The sudden and excessive expansion of export markets contributed to excessive investment in the processing sector that in turn activates a feedback loop of greater demand for fish. This in turn exacerbated all the above.

5. The poor organisational support for fish marketing resulted in the inability to convert higher physical productivity (due to the open access and new technologies) into enhanced value of output for those who laboured to harvest the fish. The beneficiaries of this were the prime actors of the market – middlemen and merchants.

6. There are now new and often conflicting uses of the coastal waters as source and sink resulting in the "space" for small-scale fisheries shrinking drastically.

7. The lack of enforceable management measures by the state, coupled with the fact that the earlier existing community-based management initiatives are now largely in disuse further contributes to the process of continued unsustainability on all counts – ecological, socio-economic, institutional and community.

**How to move towards sustainability**

Against this backdrop, the crying need in the tropical, multi-specie, small-scale fishery of the developing countries is to evolve towards a context where the triad of state, the market and the community are perceived as the three essential ingredients in any move for sustainable fisheries management. It is important to assert that the future belongs to small-scale, spatially dispersed, beach-based community operations.

The most important attribute needing redefinition is "community". The "core" community that we refer to, should consist of only the owner-workers of the small-scale fishing vessels used in the fishery.[1] All lease holder and capitalist arrangements must cease. As a matter of fact, only those who earn a livelihood in this manner from the fishery should be permitted to have access rights to the coastal waters. It is the families of this class of persons who should constitute the larger community. In the earlier form of community property rights, this was ensured by the unwritten norms. Now this may have to be codified in formal legal practice and be considered as a part of a larger package of "aquarian reforms" necessary to ensure sustainability for the living resources and the people. The access rights to the sea can be restricted to an in-shore *littoral zone* that can be appropriately defined according to the ecological and socio-political context of the country concerned. To ensure sustainability of the community, it is equally important to ensure their priority rights to the *coastal zone* contiguous to the sea, over and above the claims made by all others.

Other local residents, who do not have this "connectedness" to the fishery resource but wish to be part of the fish economy, can play their roles in the creation of organisational support to

[1] This is akin to the arrangements practiced in the coastal fisheries in Japan and in Norway until recently.

the processing and marketing activities. In fact, another facet of the aquarian reform should be an institutional arrangement wherein the right of deciding the mode and the floor price of the first sale of fish be a negotiated settlement between the "core community" and representatives of the market. The organisational apparatus to facilitate this settlement can be local cooperatives or associations in which the core community and the state (ideally perhaps at the lowest level of governance at the village level) have a role.

It is in such a co-management arrangements, where the community, the market and the state play interactive and modulating roles, that the fishery resource and the marine ecosystem is assured of both qualitative and quantitative sustainability. Perhaps, in the main, this is a sort of going back into the future.

# OBSERVATIONS ON FACTORS OF UNSUSTAINABILITY AND OVEREXPLOITATION IN FISHERIES

(in relation to Discussion Paper 1, *infra*)

by

Jake Rice

The Discussion Paper does an important service by bringing out the various dimensions of sustainability, and opening a discussion of how they inter-relate. The comments that follow should not be taken as criticisms of the preparations made by those who drafted the Discussion Paper. Rather, the ideas below might not have been prompted without a sound Discussion Paper as a starting point.

In reading the Discussion Paper it stood out that the strength of documentation for the diverse points in matrix of factors by management approach is highly variable. This should not be surprising, because in bringing together several disciples (life sciences, economics, sociology & anthropology) many of the themes are new to some disciplines, or else looked at from new perspectives. However, because the strength and completeness of technical documentation is so uneven across themes, many opportunities are presented for views that are little more than professional judgments to be mixed with principles supported by robust empirical evidence. The steps in the process which will follow this workshop will depend on the science foundation set by this meeting. Hence I think that it is important to differentiate those things that have been documented objectively and consistently across a set of case histories large enough to serve as a basis for generalization from those things which are mostly reflections of particular belief systems or conceptual or more models.

The treatment of co-management is a particularly important instance of that concern about reliability of examples. Without question it is asserted in many sources that increased user participation in decision-making results in greater compliance, lower implementation costs, and by inference, greater sustainability in all senses. However, in the governance systems I know, co-management has really only been pursued in a serious way when a large number of preconditions were met, and these biased the selection of cases strongly towards "good news stories", whatever the management actions. Experience in my area has left me with the impression that many attempts to implement co-were abandoned as some key factor (often trust) fell apart. Few if any of these cases ever make it into the literature. Before we endorse co-management as this decade's cure for unsustainable practices we should really seek a comprehensive review of co-management attempts and its complete track record of failures, partial successes and complete ones.

The Discussion Paper doesn't highlight the strong asymmetries that challenge fisheries managers. From game theory asymmetric risk and payoff schedules are known to be particularly hard games to win, but there can be winning solutions, at least in some cases. Identifying those solutions (that is, identifying management strategies that produce sustainable results in our case) requires knowing a great deal about the nature of the asymmetries. There are some high level asymmetries, such as the fact that fisheries management often occurs in a context where inaction almost ensures a poor outcome, but even a well-chosen outcome cannot ensure a good one. Fishers apply knowledge of this

asymmetry frequently when fisheries managers ask them to take "short-term pain". A similar high level asymmetry exists in the con-management relationship, where failure to have resource users support the spirit and intent of a management measure nearly guarantees the measure will not succeed, but having their support does not provide a comparable certainty that the measure will succeed. Here are many more asymmetries in the world of selecting and implementing sustainable management strategies, and concept might help provide some commonality to a number of problems being treated separately at present.

Just as there are asymmetries in the selection and implementation of management approaches, there are also some very different leverages to the different dimensions of unsustainability presented in the Discussion Paper. This is a generalization that I cannot document formally, but is based on a lot of experiences in North America and Europe. In terms of long-term consequences of management actions, without question the state of the future depends crucially on achieving ecosystem sustainability. This gives ecosystem sustainability huge leverage in consequences, because failure here, and the system must sooner or later (and usually sooner) fail on the other dimensions of sustainability as well. In the decision-making process, however, social sustainability seems to have huge leverage. Alternatives that create significant social displacement are resisted much more aggressively than alternatives that simply create some economic stress. This asymmetry in leverage of the dimensions of sustainability means the "game" of choosing management strategies may lack stable solutions unless some of the asymmetries are changed.

In the opening of 5.1 the claim is made that fisheries must be – or expected to be – profitable. That seems inconsistent with the acknowledgement of "community sustainability" as a standard different from economic sustainability. Where opportunity cost is low and alternative employment is nearly non-existent, I have the impression that people enter, and particularly stay, in fisheries that they do not expect to be profitable. This is a crucial problem for the least developed states, but is even a great issue in some coastal parts of developed states. There fishers repeatedly assert that they wish to maintain community heritage values, and they know they cannot recover equity in homes and other real property, were they to leave. This can be exacerbated by social support systems that are not promoted as fisheries subsidies, but keep people in communities where fishing is the only employment, but they know a livelihood cannot be made in the fishery. If community sustainability is to be kept as a metric of sustainability, then the precondition of profitability may need to be relaxed. Some of these considerations are picked up in 5.2.1 as well, and in Section 5.5 (Lack of alternatives). That section, in particular, is well enough reasoned, but when read carefully, parts of that section sound like we are just dodging the issue. It reads like none of us really know what will happen to communities under different management regimes, were they to be implemented well.

The treatment of non-compliance (5.6) is another area where evidence is desperately needed. We keep claiming it is a major factor, and by its nature the degree of non-compliance will be very hard to measure. Nonetheless, whether we intend to deal with it in a policy framework or a scientific one, we need more than reasoning, however sound, to put this factor into scale with other factors. This section also takes a failure-oriented view of compliance. Each failure mentioned in that section is really pointing out what happens when there is a lack of effective consultation. What is missing is how far down the sequence of management options one can go and expect to succeed, if the type of management is combined with effective consultation. Good consultation is not a management tool in itself, nor is it an exclusive characteristic of co-management.

Section 3.1, on natural variations invites misinterpretations. The third paragraph quotes deYoung *et al.*, with a statement that is clever, but unhelpful. The entire section does not make, but comes close to inviting, a plea that because of macro-scale and meso-scale inertia in environmental forcing of biological fluctuations, we should not worry too much about achieving ecological sustainability. It suggests that even with our best efforts nature will not reward us in the end. I would like to see this defeatist interpretation explicitly rejected, and two more useful things affirmed. First, natural variability does allow us to reject the concept, promoted implicitly or explicitly in some quarters, that ecosystems can be "engineered" through management actions into some desirable configuration and then kept there through more management. Second, although environmental variability is inevitable and management must react to it swiftly, we can, and should focus on management strategies that at least do not amplify the natural variability that ecosystem experience. Economic and community sustainability both probably would encourage adoption, where possible, of management strategies that buffer such variation.

Section 5.8 argues that situations where a government would both pay subsidies and charge rents would not occur, because of the logical contradiction in such practices. If there are multiple fleets exploiting a single stock or multispecies complex, the issue of community sustainability could very easily lead to situations where some fleets are subsidized and others are charged rent. This really needs to be explored seriously. The suggestion that the danger posed by subsidies is primarily encouraging riskier investments misses an effect that might be even more insidious – and widespread. It could also make the participants in a fishery much less risk averse with the state of the stock or ecosystem. If the harvesters consider themselves protected from the consequences of stock collapse, their willingness to risk it for short-term economic or community gain might be much higher.

# COMMENTS ON FACTORS OF UNSUSTAINABILITY AND OVEREXPLOITATION IN FISHERIES

(in relation to Discussion Paper 1, *infra*)

by

Keith Sainsbury

## Scope of the document

The issue should not be restricted to just large scale fisheries. Small-scale fisheries must be included, as they are important in both developing and developed countries.

## Definition of sustainability and unsustainability

This needs more development, without getting lost in details. As provided the term unsustainable is defined to only apply to collapsed resources (which needs defining here but I assume means unable to provide a fishery catch because the stock is too low to provide a yield or an economic yield). And this implies that the fishery could be regarded as sustainable (i.e. could provide an ongoing yield more or less indefinitely) at any level of abundance above the collapsed state. While remaining true to the general English language interpretation of the words, I think this misses the point for fisheries. The concept of unsustainable in a fisheries yield context (and it would need to be extended to cover ecosystem issues) needs to apply in several different situations:

- Collapsed resource (very low resource abundance)
- Resource depleted to the extent that the catch available is significantly less than the maximum long-term average that could otherwise be available (and deciding what is significant gives the operational definition for this concept).
- Resource being fished in a manner that, if continued, would result in one of the two outcomes above.

Perhaps it would be worth inventing some new terms for the different situations such as, respectively, acute unsustainability, chronic unsustainability and incipient or programmed) unsustainability. These terms could be defined in ways that are consistent with terms such as overfishing and overfished.

## Supremacy of ecological sustainability in the ecological, economic and social trio

This is a critical point. It is accepted that the full trio (ecological, economic and social) is core to sustainable development achieving goals; that no one of the trio should be maximized without regard to the others; that they are so interdependent that the idea of trade-offs among them need not arise if the full range of interactions is considered; and that many fishery management systems have overly focused their R&D capacity on the ecological while the other two are also major drivers of decision making. However, the real world experience with natural resource management is that trade-offs are made that do strongly favour maximization of one of the trio (often the short term economic, sometimes the ecological and sometimes the social), and that quite quickly and quite often natural resource use has been proved to be not sustainable. There is a need to recognize more clearly that without ecological sustainability there cannot be economic, social or institutional sustainability of a fishery. That is, within the

trio ecological sustainability has supremacy. Economic, social and institutional stability may be achieved by other (non-fishery) means depending on the scope for "substitutability" in the broadest sense, but it is only the existence of a sustainable ecological resource that can allow a sustainable fishery. Unsustainable economic practices, social approaches and management governance may persist for a time, but ultimately their limits and demise come from their ecological unsustainability rather than anything intrinsic to the economic, social or governance structure.

Also, ecological impacts such as extinction and major ecosystem disruption are likely to be essentially irreversible on human generational (and hence many human economic, social and institutional) time frames. So inter-generational equity of opportunity in relation to use of natural resources implies long-term maintenance of ecological resources and systems. And if the ecological resources are not there then inter-generational maintenance of related economic, social and institutional structures is not possible.

This may seem a bit academic, but its practical impact is significant, especially in relation to where priority should be given in the case of uncertainty, the application of the precautionary approach and in anticipatory decision-making. For example if all 3 axes of the trio are seen as having potentially equal priority then in situations of uncertain outcome there will be negotiation of a trade-off among them and the outcome will be very dependent on the representation of the interests of the trio. All three axes of the trio are rarely equally represented under most management arrangements, and in any event the fundamental problem is that ecological sustainability is necessary

**Management options**

The treatment of the management options is overly narrow in places. Especially:

- Input controls – the introductory description includes the option of controls on all aspects of fishery inputs, but the discussion and use in the rest of the text is overwhelmingly on simple limited entry.

- Rights based management – the introductory description includes rights based management applied to input controls (including area), but the discussion and use in the rest of the text is overwhelmingly about rights based on output controls.

Admittedly most applications of these two management options in the world is of the simple version (i.e. entry for input control and quotas for rights based management), but there has been significant experience with more complex variations and there is increasing interest and experimentation with more complex versions. In both cases it would be worthwhile developing subheadings for the main versions that have or are being tried, and separately discussing their implications to the unsustainability factors. These implications can differ substantially from one another across versions, and from the simple version.

**Rights based systems**

Rights based on a wider variety of input and output features should be considered, as above.

The potential for the owners of rights to act economically rationally but to the detriment of long-term sustainability should be more clearly recognized. This includes the understandable

behaviour of companies, and Governments, to significantly lower their investment time-horizons when faced with situations that threaten their future existence. This is a significant contributor to unsustainability under all of the management options.

**Management process or governance**

There are several major elements of sustainability/unsustainability that do not appear adequately recognized in the present treatment of the management scenarios. As with technology and co-management, there are features of the management or governance process that would be better treated as cutting across the other management scenarios, as they apply to all the management scenarios (except no management). These include:

- Imbalances in access to information and decision-making among legitimate stakeholders. In particular this applies to an imbalance between those with ecological, economic or social objectives as their primary focus (e.g. conservation NGOs for the ecological, fishing industry for the economic, and community interests for the social). This includes decision-making systems that are overly vulnerable to cronyism and politically favouring some (often short-term) interests over other (often long-term) interests.
- Inadequate mechanisms for operational application of the precautionary approach. This can take many forms, but include:
  - Decisions to increase or maintain fishing pressure requiring less supporting evidence, and hence time and financial resources, than decisions to decrease fishing pressure.
  - Known anti-precautionary assumptions and management strategies being adopted as the default option in the absence of information to the contrary. (For example assume one fully mixed stock, that the stock has average life history properties for the kind of organism involved, that effective fishing effort or fishing power per unit effort remains constant, that there is no miss-reporting of catch, or that there is no relationship between stock size and subsequent recruitment). Some of this is dealt with under "uncertainty", but it is the nature of the management system and its approach to precaution that is the critical issue.
  - No requirement that the selected management approach can be demonstrated to be capable of achieving the management intent under various the common fishery circumstances (e.g. the factors of unsustainability in this report). This need not be a quantitative or scientifically based argument, but rather one that provides evidence that is appropriate to the circumstance. A quantitative or science based argument is likely to be needed when the risk to significant values is perceived to be high, or when there is a serious need to convince skeptical stakeholders or third party review/assessment processes.
- Reluctance to pre-specify how common and predictable future events will be managed. This is the essence of "anticipatory decision-making", related to but separate from the precautionary approach often mentioned in Conventions, but it is very rarely put into practice at the operational level. The comments in the paper regarding the difficulty of applying the general approach derived from control theory are not helpful in this context. The management issue is to develop and state how various anticipated situations will be dealt with so as to achieve management goals. The technical details of how to approach this will vary with the situation – from expert opinion to fully quantitative analysis – but it is important not to undermine the management need for anticipatory responses on the basis of a view or problems about a particular technical approach.

**Overview**

Why, despite repeated statements and agreements of intent for sustainability, are so many fisheries overexploited - some to the point of serious collapse?

Some elements of the answer should include:

- The lack of agreed operational standards for interpreting the statements of intent. In absence of standards the interpretation is left to case-by-case decision-making processes for individual fisheries. Consequently fisheries are vulnerable to the "tyranny of small decisions" (in which undesirable outcomes result from the cumulative effects of many small decisions, none of which alone seems problematic) and capture by vested interest groups.
- Political structures - usually the bearing ultimate responsibility for balancing ecological, economic and social interests in a State - as well as many financial incentives strongly emphasize and reward short-term considerations. For many of these 3-5 year is a long time, but it is a short time in the context of many ecological processes effected by fisheries. The usual political and financial interests are not well oriented to deal with long-term ecological issues (including many related to fishing).
- There is an over-dominance of short-term interests in decision-making. This gives rise to:
  - Risk taking with excessive discounting of downside future consequences.
  - Anti-precautionary in decision making.
  - Reluctance to invest in implementation and enforcement.
  - Reluctance to invest in recovery of overexploited resources (via denial, procrastination, and lack of resource allocation for remedial or adjustment actions)
  - Poor treatment of uncertainty. Insistence on good proof before constraints are introduced which can be difficult to provide, especially if there is little investment in data observation. But significant uncertainty exists even in well-studied fisheries (e.g. bluefin tunas and cod). Uncertainty often used as reason not to constrain activities, or to take the most optimistic short-term view.

**Further points to elaborate**

Points that need to be elaborated further include, *inter alia*:

- Recognize that sometimes unsustainability is intentional. And within this the 2 cases of explicitly intentional (i.e. all stakeholders informed) and covertly intentional (i.e. all stakeholders not informed) are different in terms of causes of unsustainability, and would have different solutions.
- Intergenerational equity needs to be better dealt with.
- Arguments that accept irreversible destruction of the fishery resource as a trade-off for some other benefit are certainly possible, but they are part of a different argument about the path of development and should not be confused with the issue of sustainable fisheries resource management.
- Resource rental. Several different implementation models possible (e.g. money to Government central pool; money to pool for regional use; money to fishery

management structure for fishery in support of management activities): they have different implications for unsustainability and should be examined separately.

# NOTES ON FACTORS OF UNSUSTAINABILITY

by

Kee Chai Chong

This Workshop and the Project are a step in the right direction in seeking solutions to the continuing malaise of fisheries around the world. However, the Project must take the next steps, which involve action at field level, where the resource users are.

In developing countries in particular, awareness about the problems of fisheries management is already quite high but not many are aware of the possible solutions. Many know the causes of overfishing and fisheries habitat degradation, not least those in the industry and government. They are often aware of the know-what, know-where, and know-how. But there is no will to "just do it".

The will to take action, whether political, institutional, industry, social, communal or community is grossly lacking or not sufficiently stimulated at field level, let alone closely followed up. Lip service is given all the time to the issue. What then? In other words, how to start up and get into gear to ensure that fisheries are managed in a responsible manner. Action must be undertaken at field level and not simply addressed within the confined walls of meeting rooms. More discussions, especially at the central government level are not the answers or solutions to the continuing problems. If workshops are to be held, they should be also held at the level where it matters and where actions take place. That is in the field and with fishing communities. It is indeed at this level that more effort and hard investments into sustainable development should be expended.

The causes of unsustainability are by now well known at different levels, including at the fishers level. Fishers are able to articulate the causes of unsustainability. But they are not able to change for the better or remedy the situation or do "something" about them for a variety of reasons, which this Workshop should carefully examine.

Chief among the variety of reasons, is the lack or inadequacy of precaution in the conduct of the fishing enterprise from the pre- to the post-harvest levels. If precaution is induced and actually taken, excesses in all their forms and manifestations would not take place, especially overfishing and fisheries habitat degradation. It is the lack of precaution, driven by unregulated greed and the wrong incentives, that caused irresponsible practices.

Precaution can be taught and institutionalized. The insufficiency of precaution can be rectified through stakeholders education. More effort must be undertaken to implement the Code of Conduct for Responsible Fisheries and educate stakeholders on its basic principles. The Code's implementation so far has been half-hearted in many countries. If not seriously implemented, it may become just other instrument to be referred to from time to time. A serious effort is required to institutionalize it and to make it a part of life for fishers, fisheries managers and other stakeholders.

Institutions in all their forms (and in particular weak or poorly established institutions) could also constitute a major cause of unsustainability. This should be further elaborated by the Workshop.

As producers, our inability to live within our environmental limits is a known cause of unsustainability. But this also applies to us as consumers and people, especially in developed countries, must be made aware that their consumption patterns may be highly unsustainable (promoting higher fish consumption can translates into more investments in fisheries and higher fishing pressures on a rapidly dwindling resource base). This is a question that needs to be examined, e.g. in terms of promoting responsible fish consumption.

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This international workshop was organized in order to review and assess factors contributing to unsustainability and overexploitation in fisheries. The workshop addressed, *inter alia*: the key factors contributing to fisheries unsustainability and overexploitation and how these factors interact in general and under major fisheries management systems; the priority issues in addressing fisheries unsustainability and overexploitation; and the best practical approaches to address these factors in order to contribute to responsible fisheries management. Preliminary consideration was also given to related issues such as how and in what way these factors were addressed in international fisheries instruments and whether or not the current instruments are sufficient to address these factors.

This publication contains the report of the workshop, discussion papers and notes submitted by participants. The document and, in particular, the conclusions and recommendations adopted by workshop participants can serve as a basis for further work aimed at improved fisheries management and a more effective implementation of major international fisheries instruments.

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